SEMINAR
PROCEEDINGS

PROBLEMS AND PROSPECTS OF MARINE FISHING AND FISH PROCESSING IN KARNATAKA

EDITED BY
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and
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MARINE FISHING AND FISH PROCESSING IN KARNATAKA

(Proceedings of the Seminar held during 19–20 June, 1986 at College of Fisheries, Mangalore)

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FORUM OF FISHERY PROFESSIONALS, MANGALORE

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FOREWORD

The Forum of Fishery Professionals, Mangalore, provides a meeting ground for persons engaged professionally in fishing and fisheries activities, fishery technologists, teachers, research workers and industrialists in various institutions and organisations for exchange, discussion and dissemination of knowledge in fisheries industry, education, extension and research.

This publication of the papers presented in a Seminar on "Problems and Prospects of Marine Fishing and Fish Processing in Karnataka" conducted by the Forum at the UAS College of Fisheries, Mangalore, in June 1986, was possible due to a generous grant of Rs. 15,000/- given by the State Government through the Department of Fisheries in Karnataka. The Forum is thankful to the Government for this gesture. We are certain, that this publication will form a basic reference document for planning and development of marine fishing and fish processing activities in Karnataka for quite a few years to come.

The President of the Forum, Prof. H. P. C. Shetty, Director of Instruction, UAS College of Fisheries, was primarily responsible for obtaining the grant which made this publication possible. Our gratitude to him.

In proof reading we were assisted by Dr. (Mrs.) Indrani Karunasagar, Mr. M. N. Venugopal, Mr. K. Segar and Ms. G. Malathi Rao, all from Department of Microbiology. Mr. K. V. Saralaya, Assoc. Prof. Fish Processing Technology, helped to prepare the papers of Session IV for the press. It is with gratefulness that we record here their generous services to the Forum.

Many more members of the Forum have lent their helping hand in numerous tasks related to bringing out this publication. Our sincere thanks to all of them.

Mangalore
February, 1988.

Editors

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INAUGURAL ADDRESS

C. BYRE GOWDA,
Minister for Fisheries and Ports, Govt. of Karnataka.

I thank Sri H. P. C. Shetty, Director of Instruction (Fisheries) and organisers of the Seminar for inviting me to inaugurate and participate in this Seminar on "Problems and Prospects of Marine Fisheries and Fish Processing in Karnataka State." Since I took over as Minister for Fisheries and Ports I have been acquainting myself with the problems of the fishing industry and I have tried to solve some of them. This Seminar will give an opportunity to me to meet the fishermen, fish traders, fisheries industrialists and administrators and financing institutions in one place and to know from them their views on the problems and prospects of marine fisheries and what they expect from Government for the solution of these problems so that suitable programmes can be formulated and implemented during the Seventh Plan Period.

Karnataka State is endowed with rich fishery potential. We have a coast line of 300 kms. with continental shelf area of 25,000 sq.kms. Our inland resources are equally rich. The State has 4.00 lakh hectares of fresh water resources and 8,000 hectares of brackish water area.

The State is known for its mackeral and sardine fishery and prior to the reorganisation of the States, traditional fishing was in vogue and bulk of the landings of mackeral and sardine and other pelagic fishes were from shore seines. These traditional methods were labour intensive and provided gainful employment to the fishing community along coast. But it had limitations in terms of operational range and efficacy of gears. There were also marked fluctuations in fish landing and the average annual production was around 70,000 to 80,000 metric tonnes. Karnataka State like other states along the West Coast introduced the scheme of mechanisation in 1975 and initially trawlers were introduced as catches from these boats were shrimps which had more demand in overseas markets and fetched foreign exchange to the country. The Department started training centres to train fishermen in mechanised fishing. Boat Building Yards were also set up by the Government for the construction of mechanised boats and these boats were supplied to the trained fishermen in groups on loan cum subsidy basis. These activities led to setting up of boat building yards in the private sector and 240 trawlers were introduced under the Agricultural Refinance Corporation scheme during the period from 1967–68 to 1969–70 by the two District Fish Marketing Federations. The number of trawlers has kept on increasing and as on today we have a total of 2800 trawlers. This called for the diversification of fishing methods and during 75–76 as a part of this programme, purse-seiners were introduced for catching shoaling fishes like mackerels and sardines. During the period up to 80–81 there was a phenomenal increase in the purse-seine fleet and the State has as on to-day 396 purse-seiners. In introducing the purse-seine programme special scheme was implemented to assist traditional groups of fishermen like Rampany and Pattebale groups.

Not only these groups but other S. C. fishermen were also assisted in a big way to acquire purse-seine boats. In this programme the effort of the department of fisheries was adequately supplemented by the District Rural Development Societies of Uttara Kannada and Dakshina Kannada Districts. As a next step in mechanisation and diversification, motorised and mechanised gill netters were introduced during 80–81 and within a short spell of five years, the fleet of these boats rose to 720.

Karnataka State is perhaps the only state in the country where more than 80% of the fishermen population has been brought under the fold of mechanisation and nearly 87% of our marine catch is from the mechanised sector. Mechanised fishing, particularly purse-seine fishing has given a stability to marine fish production and our landings during 85–86 were of the order of 20,666 metric tonnes though the average landings per annum were of the order of 1,60,000 metric tonnes or so. The mechanisation has also brought a number of problems. Though the catches have gone up in absolute terms the catch per unit has progressively gone down in respect of trawlers, purse-seiners and gill netters. Earlier, a purse-seiner could catch 400 to 500 M. tonnes of fish. But per boat catch has now come down to 243 metric tonnes. The trawler catch is less than 40 tonnes and that of a gill netters 8 to 10 tonnes. This is because we have too many boats operating with the limited inshore area and fishing operations have become uneconomic because of increasing cost of mechanised boats, operational cost particularly fuel cost, spare parts and the gears. Realising the difficulties of the fishermen the State Government has introduced a scheme of granting subsidy in lieu of sales tax paid on diesel during 84–85 and a subsidy of Rs. 34–39 lakhs was sanctioned to the mechanised boats. The Government has also reduced the sales tax on nets and other requisites used by the fishermen. It is hoped that the Central Government would emulate the State Government and grant subsidy for exempting Central Excise Duty on diesel used by small fishing boats.

I understand that out of 12 crores sanctioned as a loan to fishing boats in Dakshina Kannada, as much as Rs. 9 crores is overdue. It would therefore be necessary to take a series of measures to make these units economically viable. One way is to limit the fishing boats. The Seminar will examine this aspect and make recommendations for implementation. Here again we have to ensure that the genuine needs of traditional fishermen are fully met. Secondly, I feel trawlers should not confine to trawling, purse-seiners to purse seining and gill netters to gill netting and these boats will have to operate different types of gears according to the availability of fish. The Seminar, I hope would help the Government to formulate schemes to assist the existing mechanised boats.

Though Karnataka stands out as a pioneer in purse-seine fishing, it is yet to make a beginning in off-shore and deep sea fishing. In India deep sea fishing is synonymous with Vishakapatnam as all the deep sea fishing vessels owned by different states are operated from Vizag. In Karnataka we have plans to develop Malpe as a deep sea fishing harbour. Though the harbour is ready in all respects and is being made use of by 590 small mechanised boats, it is not yet ready for the operation of deep sea fishing vessels. The harbour requires dredging and installation of slipway machinery. The execution of these two incomplete works is under active consideration of the Government.

According to the Indian Institute of Management Ahmedabad, the estimated

marine fish production potential of our coast is 5.07 lakh tonnes whereas the present level of landings has reached up to 2.00 lakh tonnes. In this context I would like to point out that a detailed survey of fishery resources in the off shore and deep sea is yet to be made. The Fishery Survey of India which had its base at Mangalore till recently has conducted some survey and the results of operations of their vessels are available. Further survey is necessary for the guidance of fishery entrepreneurs. I am assured that though the base is shifted to Goa they will continue their survey work off Karnataka Coast. The results of fishing operations conducted so far indicate that prawns are not available in commercial quantities along our coast and fishes like Tuna, pink perch, Black ruff, shark etc., are main catches. Excepting perhaps Tuna and Sharks other fishes do not have either a local or foreign market. White Bait (Anchoviella) is another species of commercial importance found in offshore waters. These could be exploited to advantage.

The Karnataka Fisheries Development Corporation has a proposal to acquire two deep sea vessels. Already 4 to 5 companies from Karnataka are operating their vessels from Vizag. I would like that more entrepreneurs from Karnataka should venture into deep sea fishing and these companies should not only operate vessels from Vizag but also for certain number of days along our coast. Their effort initially will be exploratory in nature and if they need any assistance from the State Government it will be favourably considered. Till such time Malpe harbour is ready, the vessels could be operated from commercial port at Karwar. The Government of India has a programme to have 350 deep sea fishing vessels during the Seventh Plan Period. To achieve this target the Central Government should spell out its policies clearly with regard to joint venture, chartering of vessels, financing of vessels and import of vessels. The entrepreneures are expressing their hardship in getting their projects cleared. This calls for streamlining the procedures and all encouragement should be given to take up deep sea fishing.

Another area requiring immediate attention is the development of brackish water area for prawn farming. The State has about 8 000 hectares of brackish water area 50 per cent of which can be taken as suitable for brackish water fish culture. Presently, prawn cultivation has been practised in these waters by filteration technique. The yields by these methods however are very low and lands are underutilised. Scientific cultivation of prawns in these waters, I am told, can increase prawn production to about 500 kg./per hectare/per crop and 2 crops can be taken in a year. I find that very little work has been done in this field in the State. There are problems also. The brackish water lands (Kharlands) in our state are privately owned and are under the management of tenancy farmers with occupancy rights. Also these lands are fragmented. Individual holdings are too small. Kharlands have been classified as 'D' class land and cannot be used under the existing Land Rules for prawn culture. Another constraint is scarcity of seed of tiger prawns. For these reasons it has not been possible to implement the Centrally Sponsored Scheme of brackish water farming in the State. The Marine Products Export Development Authority has funded social feasibility study of prawn farming in Karnataka State. Their Consultant Sri Rathindranath Roy visited the two coastal districts and met me and discussed several aspects of prawn farming. On receipt of his report Government will take necessary action to initiate prawn farming in the State.

I would like the Fisheries College Mangalore to set up a demonstration farm with a hatchery for the production of seed of Tiger prawn and help the Government in extending prawn culture in the State.

Fishing Harbours have been constructed at Karwar, Honnavar and Malpe and these are being made use of. Harbours are under construction at Mangalore and Tadri. Landing and berthing facilities have been provided at other landing centres. Fishery link roads measuring 103 kms. connecting fishing villages to the highways have been laid. Construction and maintenance of harbours is very expensive and beyond the resource of the State Government. It is therefore suggested that the Central Government should meet the entire expenditure on the construction of harbours instead of 50.50 basis as is the case now and the State Government will look after their maintenance.

Regarding marketing and processing, there are 91 Ice plants with a ice production capacity of 1185 tonnes per day, 37 Cold Storages with a capacity of 5037 tonnes, 27 Freezing plants with a capacity of 135 tonnes and 26 Frozen Storages with a capacity of 3130 tonnes. Besides there are 7 Canning plants with a total capacity of 24.5 M. tonnes and 10 fish meal plants with a total capacity of 129.5 M. tonnes. Many of the processing plants are underutilised. In the beginning there were as many as 70 fish processing parties in the State and I am told their number has dwindled to less than 10. The Seminar will recommend how to improve the capacity utilisation of these plants and how the existing processing plants can step up exports.

Our exports are mostly frozen shrimps and the foreign exchange earnings are around Rs. 14 to 15 crores and these figures are more or less constant. There is an urgent need to diversify marine products for exports and the Seminar will suggest how to achieve this so that by the end of the Seventh Plan the foreign exchange earnings are doubled. The Fisheries College Mangalore has a well equipped processing plant and the College can play and important role in the development of new products and to introduce them to the enterpreneures. Internal marketing of marine fish is as much important as export of marine fish. Karnataka Fisheries Development Corporation has already taken up marketing of frozen fish through its cold chain in towns and cities and has 60 centres all over the state. I would like the Corporation in cooperation with the Fish Marketing Federations and selected primary cooperative societies to take up marketing of fresh fish in all the inland districts in a phased manner.

The State Legislature has already passed the Marine Fisheries Regulation Bill and Fisheries Terminal Authority Bill and for framing rules under the Marine Fisheries Regulation Act, an Advisory Committee will be constituted and representations will be given on this Committee to different fishing interests.

As regards social welfare measures the State Government has been implementing Distress Relief Fund and Group Insurance Scheme for fishermen. It is also proposed to take up housing programme under the newly constituted National Welfare Fund for Fishermen.

I hope the discussions in this Seminar will be lively and meaningful and will make specific recommendations for the development of marine fisheries and fish processing in the State and I assure that the Government will give due consideration to these recommendations.

Thank you all

Session I: MARINE FISHING

The Present Status of Shrimp Trawling and Its Impact on Shrimp Stocks of Karnataka Coast

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ABSTRACT

An account on the present status of shrimp fishery of Karnataka coast is presented in this paper dealing with catch and effort and biological aspects such as maturity, sex ratio and breeding seasons. The impact of mechanised fishing of shrimps on the stocks of *Parapenaeopsis stylifera*, *Metapenaeus dobsoni* and *M. monoceros* has been studied which indicated that present level of effort should be maintained and the mesh size has to be increased to 30 mm in order to obtain maximum sustainable yields.

1.0. Introduction

Karnataka has got a coast line of 270 km and contributes to about 2.1% of the total shrimp landings in our country, amounting to 5054 tonnes (average for 1975–84). However, mechanised fishing for shrimps has assumed great importance in recent years due to the ever-increasing demand for prawns for export. As elsewhere, shrimp trawl, operated by various sizes of mechanised boats, formed the single major gear employed in the exploitation of shrimps in Karnataka. In addition, shrimps are also caught in traditional gears like cast net, kanthabale (bottom set gill net), and kairampani net (shore seine) during monsoon months, but contributing to negligible quantities. The introduction of purse seines in late seventies along Karnataka coast with an intention to exploit the pelagic resources, also started catching shrimps in this state as incidental catches in considerable quantities particularly in September when the fishing season commences along this coast.

Information on the shrimp resources of Karnataka is largely derived from the accounts given by the Department of Fisheries, Mysore (1962), Kuthalingam *et al* (1966) and Rao (1969). Nagabhushanam *et al* (1964) and Prabhu *et al* (1967) gave brief reports based on experimental fishing conducted over short periods. Trawl fisheries of South Kanara coast have been studied by Ramamurthy (1972, a and b) and Sukumaran *et al* (1982). Ramamurthy *et al* (1975 and 1978) and Ramamurthy (1980) studied the resource characteristics of a few species of shrimps of this area. Recently, the mechanised shrimp fishing of Mangalore coast for the seasons 1970–80 has been studied by Rama murthy and Sukumaran (1984). Radhakrishnan (1967) and Bapat *et al* (1972) have given the results of the exploratory survey conducted by Indo-Norwegian Project vessels off Karwar. With a view to elucidating the impact of intensive mechanised fishing on the shrimp resources of Karnataka, extensive studies have been carried out by Central Marine Fisheries Research Institute.

The fluctuations in the shrimp landings during the last ten years in the Karnataka coast are seen in Table 1. An attempt has

Table 1. Shrimp landings in Karnataka during 1975–84

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Shrimp (tonnes)	3074	2594	3335	8440	4660	3226	4126	7698	7883	5506

been made in this paper to study the shrimp fishery of this coast and indicate the steps to be taken for proper management.

2.0. Collection of Data

Fish landing centres were visited twice a week and data on shrimp catch and effort, species composition by weight were estimated based on sampling 10 to 20% of the units operated. To estimate the monthwise catch, the average weight of the catch per boat on observation day was multiplied by the number of units in operation on that day. The total catch on observation days was thus estimated and raised to the month based on the number of actual fishing days to get the monthly catch.

Males and females were sorted out and total length of the prawn was measured between the tips of telson and rostrum. The different stages of maturity were determined by gross examination of ovary as well as by detailed studies under a binocular microscope.

3.0. Resources and their Exploitation

3.1. Commercial species of shrimps and their distribution

In Karnataka, the shrimp fishery is largely supported by smaller species like *Metapenaeus dobsoni* and *Parapenaeopsis stylifera*. In addition, larger varieties, such as, *M. affinis*, *M. monoceros*, *Penaeus indicus*, *P. monodon* and *P. merguiensis* are also found in fairly good quantities.

Shrimps are generally caught from 10 to 40m depth by trawl net. During the beginning of the fishing season, shrimps are seen to concentrate in the nearshore waters within 18m depth. As the season advances, they move out to slightly deeper areas. From November to May, smaller species like *M. dobsoni* and *P. stylifera* are predominantly caught at 10–26m depth, while larger ones like *M. monoceros*, *P. indicus* and *P. monodon* are abundant in areas further deep between 30–55m depth.

3.2. Fishing seasons and craft and gear employed

The machanised fishing is done during September–May period, and the fishing by indigenous gears is confined to June–August when all mechanised fishing activities remain suspended along this coast due to southwest monsoon rains. Mechanised fishing is carried out by shrimp trawlers and purse seiners and traditional gears like shore seine, cast net and gill nets are used for indigenous fishing.

3.2.1. TRAWL FISHERY

3.2.1.1. Craft and gear and their operation

Boats of varying lengths from 6.70m to 10.97m fitted with 20 to 96 H.P. engine using otter trawl (length ranging from 18 to 30m) with wire rope of varying lengths are operated along the Karnataka coast. A few vessels (13.2m) fitted with 120 H.P. engine are operated during peak seasons along South Kanara coast. The mesh size at the cod end of trawl net varied from 16 to 25mm.

Around 2000 trawl units are operating along this coast. Of this, about 1250 units are in South Kanara alone, and most of them are centred around Mangalore, Malpe and Ganguli mainly due to the availablability

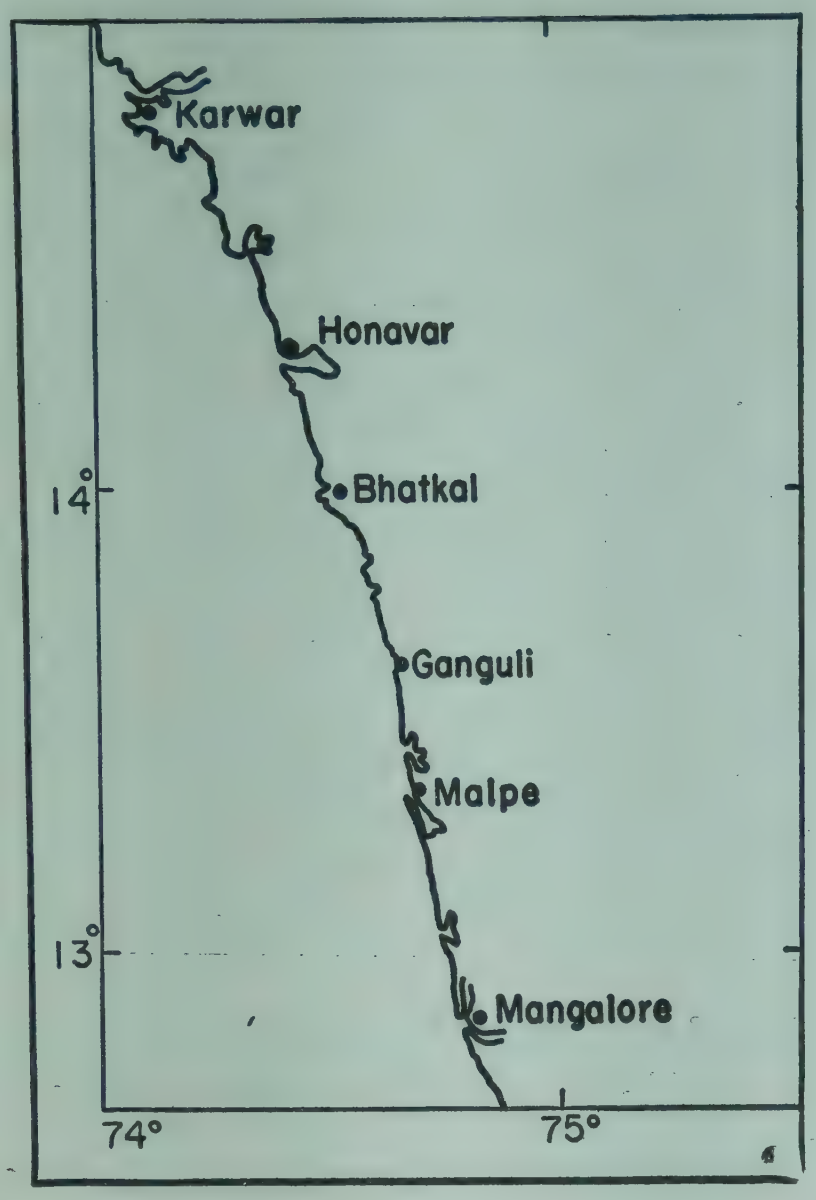

Fig. 1. Map showing important marine fish landing centres of Karnataka State

of infrastructural facilities like storage, transport, market etc. In addition, some boats are operated from Padubidri, Polippu, Hangarakatta, and Tarapathy. In North Kanara, trawling is carried out from Bhatkal, Tengingundi, Honnawar, Tadri, Keni, and Karwar (Fig. 1).

Generally these trawl units make daily cruises. The day fishing vessels leave in the early hours of the day and return to their base in the afternoon. Sometimes landings are continued till evening.

Night trawling is carried out by larger boats only (measuring more than 9.75m) and that too from December to April. These boats generally operate upto a depth of 50–55m for catching larger varieties of shrimps which are brought to the landing centre in large insulated ice boxes on the following day. Sometimes some of these units at Mangalore return to their base after 2 or 3 night-fishing. The number of hauls made by each unit vary from 1 to 3 per day with an average of 2 hauls, each lasting 2–3 hours in the case of day fishing and 4–5 hours in the case of night fishing.

3.2.1.2. Catch and effort at different centres

Mangalore

The annual landings of shrimps and effort showed fluctuations (Table 2). For the 13 seasons from 1971–72 to 1983–84, the maximum, the minimum and the average landings were 3644.7 t (1973–74), 673.1 t (1980–81) and 1682.4 t respectively.

The effort in number of units ranged from 26554 boats (1980–81) to 48816 boats (1976–77) with an average of 35772 boats during this period.

There was steady increase of effort from 121968 hours during 1971–72 to 219675 hours during 1976–77. Since then, it showed a declining trend upto 1980–81, except for a marginal increase in 1978–79. Thereafter, it increased to an all time high value of 278752 hours during 1983–84.

Together with effort, the shrimp catch also increased from 1627.1 t (13.3 kg/hour) during 1971–72 to 3644.7 t (26.9 kg/hour) during 1973–74 and thereafter, showed a declining trend. By 1980–81, the shrimp catch dwindled to 673.1 t (5.6 kg/hour) showing a fall of 81.5% from a peak in 1973–74. The catch, however, showed improvement to 2065.2 t (7.5 kg/hour) during 1982–83.

The average catch data for the season 1971–72 to 1983–84 indicate that the best catches were obtained during the third quarter, viz. January–March, when around 46% of the annual shrimp catch was

Table 2. Catch in tonnes and effort at Mangalore, Malpe and Karwar

Fishing season	MANGALORE No. of units	Fishing hours	Prawn catch	Catch/ hour in kg.	MALPE No. of. units	Fishing hours	Prawn catch	Catch/ hour in kg.	KARWAR No. of units	Fishing hours	Prawn catch	Catch/ in kg. hour
1971–72	27104	121968	1627.1	13.3	—	—	—	—	3497	17485	122.0	7.0
1972–73	29020	130590	1575.1	12.1	—	—	—	—	6295	31475	348.8	11.0
1973–74	30149	135671	3644.7	26.9	—	—	—	—	6246	31230	266.0	9.5
1974–75	31427	141422	2229.4	15.8	—	—	—	—	2642	13210	156.7	11.9
1975–76	39406	177327	1943.4	11.0	—	—	—	—	5984	29920	414.1	13.8
1976–77	48816	219675	1427.0	6.5	—	—	—	—	2517	12585	173.5	13.8
1977–78	38602	173709	1777.6	10.2	—	—	—	—	2211	11055	245.4	22.2
1978–79	40418	181881	1384.4	7.6	—	—	—	—	7438	37190	581.3	15.6
1979–80	32502	148507	959.8	6.5	—	—	—	—	7214	36070	456.6	12.7
1980–81	26554	119890	673.1	5.6	—	—	—	—	12720	63600	534.7	8.4
1981–82	34196	153944	984.2	6.4	24785	111575	569.4	5.1	21004	105020	519.4	4.9
1982–83	45553	275513	2065.2	7.5	30248	165179	769.0	4.6	27831	139155	1048.5	7.5
1983–84	41287	278752	1578.6	5.7	37102	208380	983.3	4.7	15138	75690	583.6	7.7

obtained. This is followed by fourth quarter (April-June) which contributed 18% and the rest by the first quarter (July–September.)

Malpe

The shrimp catch at Malpe steadily increased from 569.4 t in 1981–82 to 983.3 t in 1983–84. The number of units increased from 24785 boats in 1981–82 to 37102 units in 1983–84, thereby, registering an increase in effort by 50%. Similarly, the fishing hours also increased from 111575 during 1981–82 to 208380 hours during 1983–84, resulting in the reduction of CPUE from 5.1 kg/hour in 1981–82 to 4.7 kg/hour in 1983–84.

The average annual prawn catch and catch rate were 773.9 t and 4.8 kg/hour respectively

Karwar

Catch and effort showed considerable fluctuations. For the 13 seasons from 1971–72 to 1983–84, the maximum, the minimum and the average shrimp landing were 1048.5 t (1982–83), 122.0 t (1971–72) and 419.0 t respectively.

The effort in number of units ranged from 2211 (1977–78) to 27831 units (1982–83) during the period.

The effort in hours increased from 17485 in 1971–72 to 31475 in 1972–73. It was more or less the same in 1973–74 (31230 hours). The season 1974–75 witnessed a sharp fall in effort in hours by 58% as compared to the previous season. After registering an increase in 1975–76 (29920 hours), it decreased to 11055 hours by 1977–78. Further, there has been a sharp increase in effort over the years up to 1982–83 season when maximum effort was recorded (139155 hours). The following season, 1983–84, registered only 75690 hours thereby showing a fall in effort by 46% as compared to the previous season.

Although there was wide fluctuations in shrimp catch, it increased from a moderate catch of 122.0 t (7.0 kg/hour) in 1971–72 1048.5 t (7.5 kg/hour) in 1982–83 (Table 2).

3.2.1.3. Species composition and their relative abundance at various centres

The different category of shrimps showed

considerable fluctuations in their catches during different fishing seasons and also during various months of the same season.

M. dobsoni and *P. stylifera* together contributed to the bulk of the shrimp catch (70 to 84%) and among these two, one or the other species was found to dominate the fishery. *M. dobsoni*: At Mangalore, during 5 out of 13 seasons covered in the present study, this formed the principal species. It contributed 36.6% of the average annual shrimp catch. The best catch of 1780.6 t with a catch rate per hour of 13.1 kg was obtained during 1973–74. The catch of this species was generally high in January and sometimes in September.

At Malpe, this species formed 34.1% of the annual average catch of shrimps. The best catch of 390 tonnes with a catch rate per hour of 1.9 kg was realised during 1983–84. September and December–May were the peak seasons for this species.

At Karwar, *M. dobsoni* contributed to 28.4% of the shrimp catch forming the second important species in abundance. This was the chief species during 3 out of 13 season studied at present. Maximum catch of 238.0 t with a catch rate of 6.4 kg/hour was recorded during 1978–79.

M. affinis: At Mangalore, this species contributed 5.4% of the annual average catch of shrimps. The maximum catch of 164.1 t and catch per hour of 1.2 kg were realised during 1974–75. This shrimp was caught in moderate quantities during April–May.

At Malpe, this species formed 2.3% of the shrimp catch. The maximum catch of 29.5 t was obtained during 1981–82.

At Karwar, 12.7% of the annual average catch of shrimp was contributed by this species. The peak season of occurrence was 1982–83 when 174.0 t of this variety of shrimp was caught.

M. monoceros: This species was generally caught from a depth of 30–55 m. It formed 6.2% of the annual average catch of shrimp at Mangalore. The highest catch of 475.3 t and catch per hour of 2.16 kg was obtained during 1976–77. The best period of occurrence was December–March.

At Malpe, it formed 17% of the shrimp catch. The highest catch of 191.6 t with 0.9 kg/hour was recorded during 1983–84. The peak period of occurrence was December –April.

At Karwar, this species formed 15% of the annual average catch of shrimps. It contributed upto 39.5% of the shrimp catch during 1980–81. The highest catch of 217.0 t (1.6 kg/hour) was obtained during 1982–83.

P. stylifera: At Mangalore, this was the principal species in 8 out of the 13 seasons under study, forming 46.7% of the annual average catch of shrimps. This species was caught together with *M. dobsoni* from 10–25 m depth. The best catch of 1667.8 t and catch per hour of 12.3 kg were available during 1973–74. The period of maximum abundance of this species in the fishery was during December and April-May.

At Malpe, this species formed 36.7% of the total shrimp catch. Out of the three seasons studied, this shrimp was the principal species during two seasons. The maximum catch of 341.4 t with 2.1 kg/hour was realised during 1982–83. September and December–May were the peak periods of occurrence for this shrimp.

At Karwar, *P. stylifera* formed 42% of the shrimp catch and dominated the fishery in

9 seasons out of the 13 seasons under study. The maximum catch of 439.0 t (5.6 kg/hour) was realised during 1983–84.

P. indicus: At Mangalore, this species formed only 4.0% of the annual average shrimp catch. The best catch of 140.5 t and catch per hour of 0.64 kg were obtained during 1970–77. The fishery was relatively better during March–May. At Malpe, *P. indicus* contributed to 4.2% of the shrimp catch. The best catch of 61.0 t was recorded during 1983–84. At Karwar, this species formed 0.4% of the annual average catch of shrimps. The highest catch of 11.9 t was obtained during 1978–79.

P. merguiensis: The catch wss negligible at Mangalore and Malpe. At Karwar, tnis species contributed upto 1.4% of the annual average landings of shrimps. The highest catch of 33.6 t was recorded during 1973–74.

Other species like *Parapenaeus longipes*, *Trachypenaeus curvirostris*, *Metapenaeus moyebi* and *Parapenaeopsis acclivirostris* were found to occur in the trawl catches in small numbers during certain period of the year. *P. longipes* was landed in good numbers during April–May 1980 (Sukumaran, 1985). In addition, non–penaeids like *Nematopalaemon tenuipes*, and *Hippolysmata ensirostris* also occured in stray numbers.

3.2.2. PURSE SEINE FISHERY

3.2.2.1. Craft and gear and their operation

Purse seiners are wooden boats measuring 12 to 13.5 m in length fitted with 90–120 HP engine. The net is made of nylon and, it measures upto 600 m in length with a mesh size of 14–18 mm. These boats make daily cruises and operate 3–4 hauls per day. The time taken for each haul varies from 1 to 3 hours depending on the size of the catch. Purse seiners operate their net upto 50 m depth. Around 300 purse seines are operating along the Karnataka coast.

3.2.2.2. Catch at different centres

Generally, shrimps, being demersal, are not caught in purse seins. It is found that sometimes they are caught in large quantities in these nets particularly in September at 10–18 m depth, when the fishing season commences after S. W. monsoon (Table 3).

Mangalore

The maximum, the minimum and the average catch recorded were 1244.0 t (1983–84), 6.6 t (1981–82) and 523.6 t respectively It is interesting to note that shrimps alone formed 48% of the purse seine catch during the first half of September 1983.

Malpe

The shrimp catch was fairly high during 1983–84 when 565.5 t were caught in purse seines. The average catch amounted to 256.0 t for the four seasons (1980–81 to 1983–84).

Karwar

It is estimated that 39.0 t of shrimps were landed by purse seins in September 1983 (Table 3).

3.2.2.3. Species composition and their relative abundance at different centres

M. dobsoni and *P. indicus* were the only two species recorded in the shrimp catches

Table 3. Shrimp landings in tonnes by purse seines at Mangalore, Malpe and Karwar

	Mangalore	Malpe	Karwar
1980–81	395.0	122.2	—
1981–82	6.6	15.0	—
1982–83	449.4	320.9	—
1983–84	1244.0	565.5	39.0

by purse seines. *M. dobsoni* was the most abundant species contributing to the bulk of the shrimp catch. It formed 97–98% of the shrimp landings by purse seines at Mangalore and Malpe. *P. indicus* formed the rest of the catch. On the otherhand, the purse seine catch was exclusively comprised of *M. dobsoni* at Karwar.

3.2.3. INDIGENOUS SHRIMP FISHERY

When all mechanised fishing operations remain suspended during the southwest monsoon period (June–August), indigenous gears like cast net, kanthabale (bootom set gill net), kairampani (shore seine) etc., are operated along Karnataka coast mainly to catch shrimps and other fishes.

3.2.3.1. Craft and gear

The details of the craft and gear employed in the traditional fishery and their mode of operation are given by Prabhu *et al* 1973.

3.2.3.2. Catch

The maximum catch of 11.4 t of shrimps was recorded during 1980–81 at Ullal near Mangalore. At Baikampady (near Mangalore), the best catch of 8.8 t was realised during 1981–82. The shore seines landed the maximum catch of 27.3 t during 1982–83 at Karwar (Table 4).

3.2.3.3. Species composition at different centres

M. dobsoni was the most abundant species forming 80–100% of the prawn catch

Table 4. Shrimp landings in tonnes by indigenous gears at Ullal, Baikampady and Karwar

	Ullal	Baikampadi	Karwar
1980–81	11.4	1.2	21.2
1981–82	—	8.8	10.8
1982–83	4.2	2.7	27.3
1983–84	—	—	—

Table 5. Chi-square value for different category of shrimps landed at Mangalore

	1978			1979			1980			Pooled		
	Degrees of freedom	Chi square value	Significant or not	Degrees of freedom	Chi square value	Significant or not	Degrees of freedom	Chi square value	Significant or not	Degrees of freedom	Chi square value	Significant or not
M. dobsoni	8	112.3250	S	9	96.1866	S	9	32.9295	S	9	68.1515	S
M. affinis	3	4.2305	NS	6	1.9260	NS	5	21.3215	S	7	7.7550	NS
M. monoceros	5	12.7655	S	5	7.3663	NS	4	7.2853	NS	5	15.8234	S
P. indicus	7	10.3783	NS	8	21.9918	S	7	12.5947	NS	9	10.4922	NS
P. stylifera	6	18.4712	S	7	8.1337	NS	6	51.0931	S	7	27.4881	S

followed by *P. indicus* in the traditional gears at Mangalore.

Shore seine catch at Karwar was mainly consisted of *P. stylifera*, *M. dobsoni*, *P. merguiensis* and *P. indicus* and the former species dominated the fishery during most of the seasons.

4.0. BIOLOGY OF COMMERCIALLY IMPORTANT SPECIES

4.1. Sex distribution

Considerable variation in the distribution of sexes was noticed during different months in all species. Even within a month, difference in the proportion of sexes was observed among various samples analysed for study. In order to ascertain statistically whether there was any significant difference in the proportion of sexes in the monthly samples during different years, the Chi-square test was applied to the data collected from Mangalore and results are presented in Table 5. In the case of *M. dobsoni*, *P. stylifera* and *M. monoceros* the Chi-square values were significant at 5% level suggesting that there was considerable variation in the proportion of sexes in these species. On the otherhand, the chi-square values were not significant at 5% level in *M. affinis* and *P. indicus* showing that the distribution of sexes was more or less equal.

The overall sex ratio (Table 6) indicated

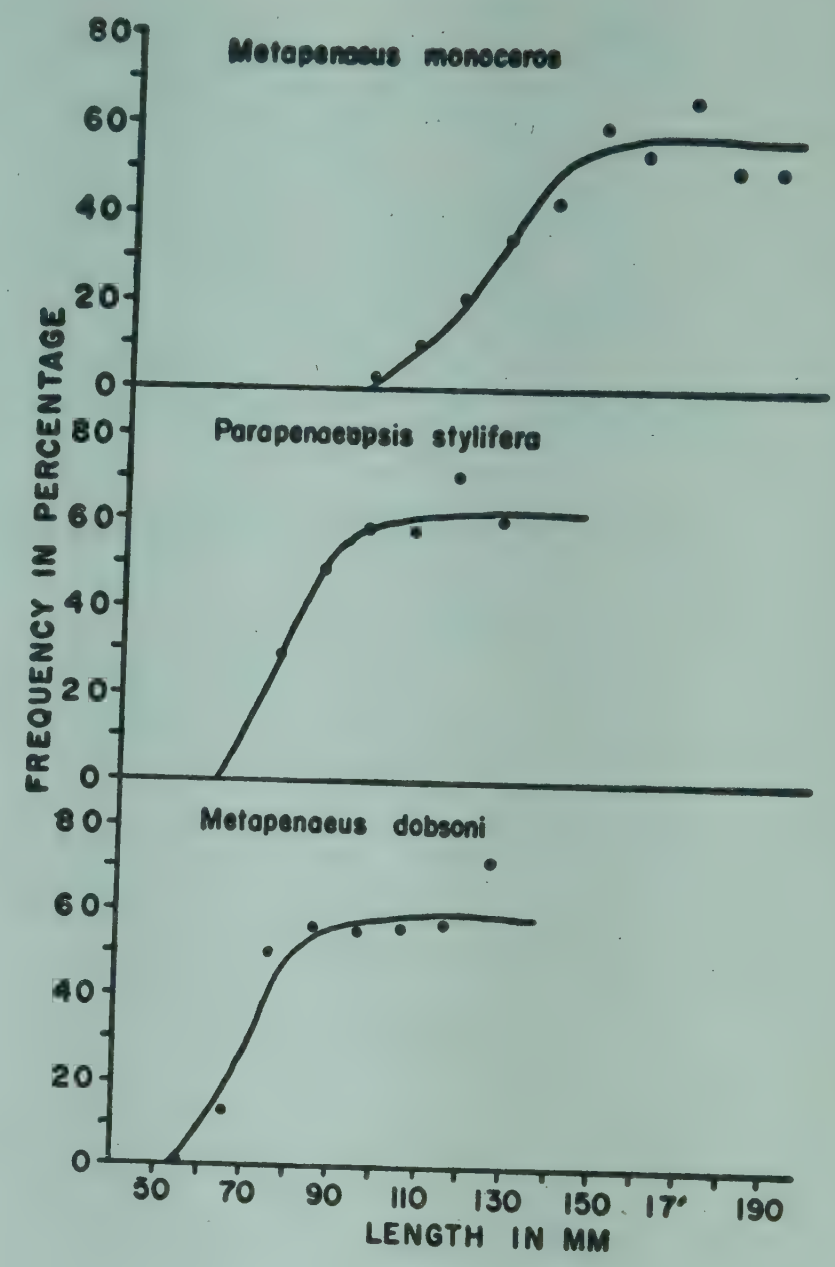

Fig. 2. Sizes at first maturity of three commercially important species of shrimp in the Karnataka coast.

that females out numbered males in all species except in *M. monoceros* at Karwar in which females formed only 44.0%.

4.2. Size at first maturity

The size at first maturity at 50% level was found to be 80.0, 135.5 and 85.0 mm for *M. dobsoni*, *M. monoceros* and *P. stylifera*

Table 6. Sex ratio in percentage in various categories of shrimps at different centres

	Mangalore		Malpe		Karwar	
	Males	Females	Males	Females	Males	Females
M. dobsoni	45.0	55.0	49.4	50.6	49.9	50.1
M. affinis	37.5	62.5	—	—	—	—
M. monoceros	46.7	53.3	—	—	56.0	44.0
P. stylifera	43.7	56.3	39.5	60.5	44.5	55.5
P. indicus	46.7	53.3	—	—	—	—

Table 7. Peak period of spawning in various categories of shrimps in different centres

	Mangalore	Malpe	Karwar
M. dobsoni	March–September	September & January–February	January–May & August & November
M. affinis	December–April	—	—
M. monoceros	February–April	—	January–March
P. stylifera	March–April	November & February–March	January–April October–November
P. indicus	February–April	—	—

(Fig. 2). The smallest prawn with fully mature ovary measured 63 mm for *M. dobsoni*, 108 mm for *M. monoceros* and 73.0 mm in the case of *P. stylifera*.

4.3. Breeding season

Based on the monthwise distribution of mature females during various seasons, the spawning season of the different species was determined. Though all these species have a protracted breeding period, the peak season for individual species is found to vary from centre to centre. The peak period of spawning for the species for different centres is given in Table 7.

5.0. STOCK ASSESSMENT OF *P. STYLIFERA*, *M. DOBSONI* AND *M. MONOCEROS*

As seen earlier major contribution to the shrimp landings was from *P. stylifera* and *M. dobsoni*. Detailed length frequency data on biological aspects are available at Mangalore and Karwar for more than ten years and data on *M. monoceros* on these aspects for Karwar. Hence stock assessment studies were undertaken for *P. stylifera* and *M. dobsoni* for Mangalore and Karwar and for *M. monoceros* for Karwar. To a certain extent this would reflect on the overall shrimp fishery of the Karnataka region for arriving at valid conclusions. For this purpose using length frequency data (Alagaraja, 1984, Alagaraja *et al* 1985) estimates of vital parameters such as instantaneous mortality rate (Z), l_∞, and K have been obtained. Using M=K the instantaneous natural mortality rate, M and hence F the instantaneous fishing mortality rate, have been estimated. The consistant of the estimate Z could be inferred from its standard error, s_Z From the data estimates on the size at recruitment, lr and the size at first capture, lc were also obtained. From the length-weight relationship estimates on W_∞ were also obtained. The exploitation rates $E\left(=\frac{F}{Z}\right)$ for each species for each region were calculated from the available estimates on F and Z. These estimates are presented in the tables 8 to 10 for ready

Table 8. Estimates of l_∞, W_∞ and K (monthly)

Species	Sex	Area	l_∞ (mm)	W_∞ (gm)	K
P. stylifera	Males	Mangalore	125	15	0.41
		Karwar	135	16	0.29
	Female	Mangalore	145	19	0.41
		Karwar	150	20	0.29
M. dobsoni	Males	Mangalore	135	18	0.41
		Karwar	135	18	0.51
	Females	Mangalore	145	20	0.29
		Karwar	145	20	0.29
M. monoceros	Males	Karwar	190	70	0.47
	Females	Karwar	225	110	0.45

Tabje 9. Estimates of $\bar{Z}$ (monthly) and its standard error ($S_{\bar{Z}}$), 'n' the sample size, lc (mm) and lr (mm)

Species	Sex	Area	$\bar{Z}$	$S_{\bar{Z}}$	n	lc	lr
P. stylifera	Males	Mangalore	1.66	0.18	16	75	45
		Karwar	0.85	0.20	17	80	50
	Females	Mangalore	0.76	0.09	26	85	50
		Karwar	1.05	0.38	23	95	55
M. dobsoni	Males	Mangalore	1.26	0.14	19	75	45
		Karwar	1.60	0.23	11	75	50
	Females	Mangalore	1.21	0.12	22	90	45
		Karwar	1.03	0.11	12	90	50
M. monoceros	Males	Karwar	3.16	0.64	5	75	60
	Females		1.06	0.10	13	125	65

Table 10. Estimates of M, F, E and C

Species	Sex	Area	M	F	E	C
P. stylifera	Males	Mangalore	0.41	1.25	0.75	0.60
		Karwar	0.29	0.56	0.65	0.60
	Females	Mangalore	0.41	0.35	0.45	0.60
		Karwar	0.29	0.76	0.70	0.64
M. dobsoni	Males	Mangalore	0.41	0.85	0.70	0.56
		Karwar	0.51	1.09	0.70	0.56
	Females	Mangalore	0.29	0.92	0.75	0.62
		Karwar	0.29	0.74	0.70	0.62
M. monoceros	Males	Karwar	0.47	2.69	0.85	0.40
	Females		0.45	0.61	0.60	0.56

reference and for further details one may refer to Alagaraja *et al* (1985). The raising factors (R) for obtaining the actual isopleths values were obtained from $R=W_\infty (1-l_r/l_\infty)^{-\frac{M}{K}}$.

Mangalore

From the yield tables for M/K=1, E=0.75 and C=0.60 it is seen that the level of MSY is attained at this level only. Hence the present intensity of fishing pressure and the mesh size appear to be ideal one so far as the stock of males of *P. stylifera* at Mangalore is concerned. However, when E=0.75 is fixed, in other words at the present rate of effort the MSY level can be increased to 1.03 times of the present level if the mesh size is increased to 1.13 times of the present size so as to have C=0.68 or lc=85 mm instead of lc=75 mm at present. Regarding females, there is every likelihood to increase the MSY level by increasing the effort pressure to the level E=0.75. However, considering males and females together, the present level of effort and the mesh size may be maintained for obtaining the present catch levels for years to come without affecting the stocks of *P. stylifera*.

In the case of *M. dobsoni* off Mangalore, the stock of males will remain unaffected at the present level of effort and mesh size. However, if C is raised to 0.66 leading to lc=90 mm MSY level may be obtained increasing the yield to 1.03 times. Regarding females, the present levels of effort and mesh size are expected to lead to MSY levels without affecting the stocks.Hence increasing mesh size would be beneficial for the stocks of males and females.

Considering the above facts it is clear that present status of fishing will not affect the stock of *P. stylifera* and *M. dobsoni* off Mangalore and this level may be maintained so as to reap sustainable yields from these two species. Since these two species form the major components of shrimp landings in the region, this remark holds for the shrimp fishery of Mangalore coast as well.

Karwar

Regarding the two species namely *P. stylifera* and *M. dobsoni* the conclusions arrived at for the Mangalore region holds good for Karwar region also as the values of E and C are more or less same here. However, for *M. monoceros* at the level of C=0.40 the yield level is almost half, when E=0.85, that of when C=0.70 implying that mesh size is to be increased substantially so as to get lc=130 mm against the present lc=75 mm. In the case of females, the present levels are not deleterious. Hence increasing mesh size would be better for these stocks.

Taking the shrimp stocks of both Mangalore and Karwar regions it could be said that at the present level of effort pressure maximum sustainable yields can be obtained if the mesh size of trawls are increased to 1.13 times. In other words it would be better for the shrimp fishery if the present mesh size of 25 mm is increased to 30 mm. Yield isopleths are drawn and given in Fig. 3. A single figure is given for ready reference as the same can be used for the species and regions concerned with suitable raising factors given in the Table 11.

To obtain the actual yield per recruit, the values indicated in the Fig. 3 are to be multiplied with the corresponding raising factors from the table. For instance the isopleth indicating 0.10 represents 2.34 gm for *P. stylifera* males at Mangalore. This is obtained by multiplyiog 0.10 with 23.4375 the raising factor for *P. stylifera* males in the table. Similarly one can obtain yield per

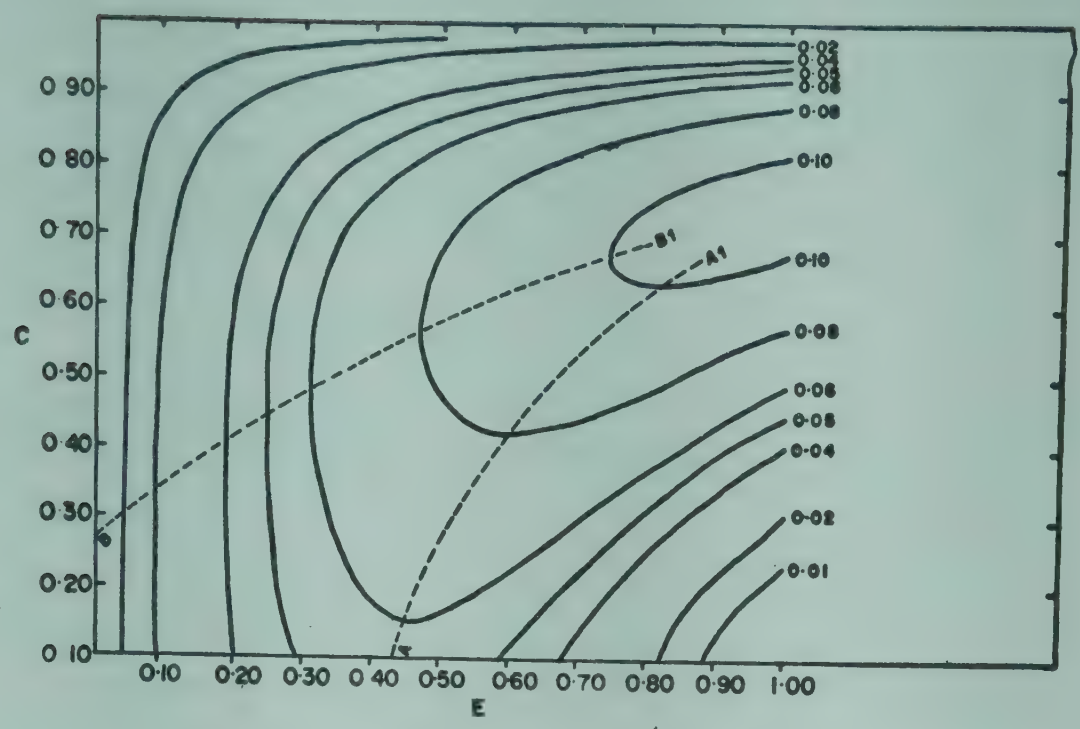

Fig. 3. Yield—Isopleths

Table 11. Raising Factors for obtaining yield per recruit from the graphs

Species	Area	Males	Female
P. stylifera	Mangalore	23.4375	27.4736
	Karwar	25.4118	31.5789
M. dobsoni	Mangalore	27.0000	29.0000
	Karwar	28.5882	30.5263
M.monoceros	Karwar	102.3077	154.6875

recruit values for others in Mangalore and Karwar regions.

6. CONCLUSIONS

As in other areas of the coast the annual shrimp landings in Karnataka showed wide fluctuation ranging from 2594 t to 8440 t with an average of 5054 t during 1975–84, the bulk of the catch coming from the South Kanara, particularly from Mangalore. The fishery is largly supported by smaller sized species such as *M. dobsoni* and *P. stylifera*. Among the species studied for sex ratio, only in the case of *M. affinis* and *P. indicus* males and females were found to occur in equal proportions. The size at first maturity at 50% level has been estimated at 80.0 mm for *M. dobsoni*, 85.0 mm for *P. stylifera* and 135.5 mm for *M. monoceros*. Rao (1968) observed the minimum size at first maturity at 64 mm and 63 mm in *M. dobsoni* and *P. stylifera* respectively from Cochin waters. According to George (1959) *M. monoceros* does not mature before attaining 120 mm size which has been confirmed by Nalini (1976).

As observed in these shrimps in other areas, the breeding periods is protected with distinct peak seasons for each species. But a noteworthy observation in the present study is the slight difference noticed in these peak seasons among the different centres of obsrvations (Table 7). Whether this difference in the peak period of breeding is correlated with the movement of the stock between the centres is a problem worth studying. Further studies on movement of the stocks in between centres of trawling operations by employing extensive mark recorded experiments would go a long way in solving this problem.

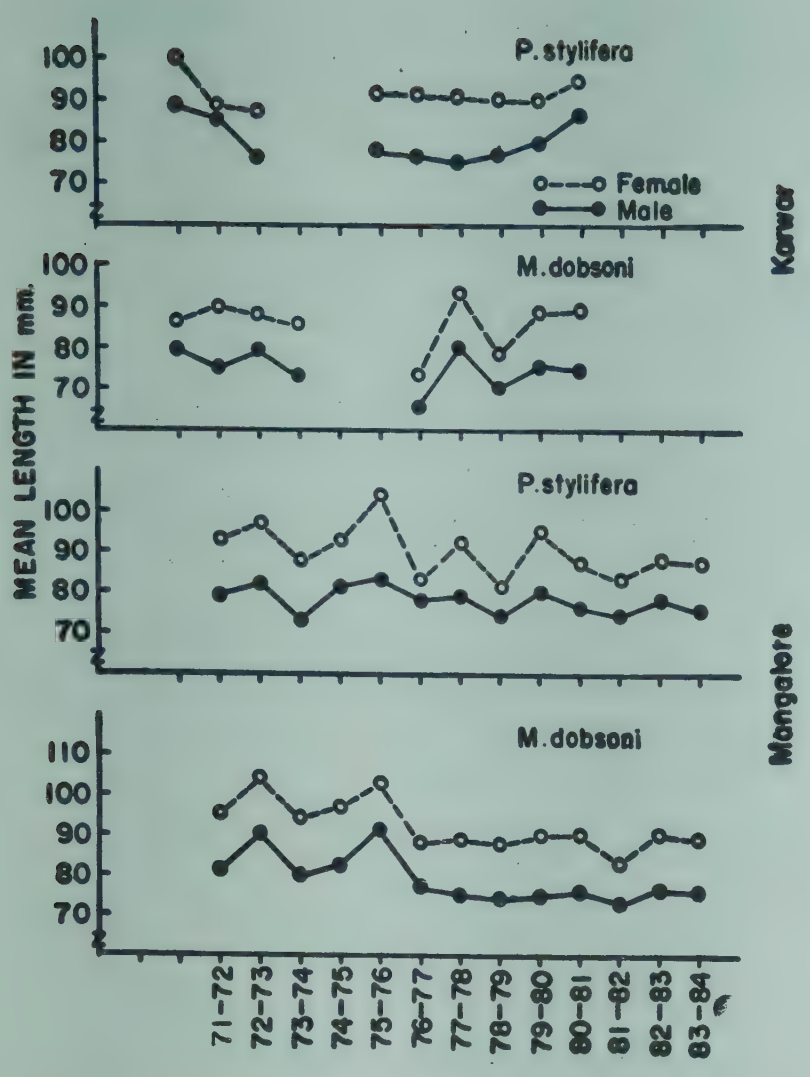

Fig. 4. Trend in mean sizes of *P. stylifera* and *M. dobsoni* at Mangalore and Karwar centres.

Fishing in India, particularly in Karnataka coast, was previously dominated by passive gears such as rampanis (shoreseine). With the adevent of trawling and purse seining the set up has been changed as these gears are active in the sense that they hunt the stocks and indulge in indiscriminate exploitation which would affect the stocks. However, the present analysis has indicated that the effort exerted on the stocks of shrimps is just at the level where maximum sustainable yield could be obtained without adversely affecting the stocks. The mean sizes from the landings (Fig. 4) have also indicated that there is no downward trend in recent years thus supporting the above conclusion. Moreover, to increase the mesh size to 30 mm will also go a longway to maintain the renewability of these dynamic resources, as this step will naturally increase the size at first capture, which in turn, will ensure recruitment to the fishable stock. This conclusion is well supported by the sizes at first maturity (Fig. 2) of the three species *P. stylifera*, *M. dobsoni* and *M. monoceros*. To conclude it may be said that the present effort level may be maintained and mesh size of trawl net may be increased to 30 mm so that maximum sustainable yield from shrimps could be obtained from the Karnataka coast.

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Present Status and Prospects of Exploitation of Pelagic Fisheries Resources of Karnataka Coast

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ABSTRACT

Pelagic species dominated by oil sardine (*Sardinella longiceps*), mackerel (*Rastrelliger kanagurta*) and anchovies (*Stolephorus* spp.) contribute 53% to 77% of the total marine fish landings of Karnataka which varied from 1.12 lakh tonnes to 1.55 lakh tonnes during 1980–84. The production from the palegic fisheries showed wide fluctuations over the years (1971–1984) especially so in the two dominant species namely oil sardine and mackerel. However, after the introduction of purse seine in the Karnataka coastal waters in mid-seventies, the total marine fish production has reached initially a peak and then a plateau. Presently the marine fishery of Karnataka is confined to 0–50 m depth zone, more intensively in the 0–30 m depth. The landings of whitebait-another single resource with very high potential—in large quantities in recent years gives vast scope for further intensive exploitation of them in the 30–50 m depth. Recent exploratory surveys indicated the availability of large stocks of oil sardine, mackerel, whitebait and carangids in the depth zone 20–75 m Besides the above resources there are a number of other species like coastal tunas, ribbon fish, lesser sardines and oceanic resources like tuna, pelagic sharks and squids which have sizeable stocks.

Introduction

The average annual marine fish production of Karnataka during the period 1980–84 was in the order of 1.32 lakh tonnes. More than 50% of these landings are from the pelagic species. Notable contributions among pelagics are from Oil sardine (*Sardinella longiceps*), mackerel (*Rastrelliger kanagurta*) and anchovies (*Stolephorus* spp.). Wide fluctuations in the marine fish landings in the Southwest coast have been found to be due to fluctuations in the landings of pelagics and Karnataka coast is no exception to this phenomenon. The pelagic resources in this region should therefore be critically examined as to know whether there is scope for increasing their contribution to the marine fish landings. At present the exploited areas are mostly within 50 m depth. The data collected by the Central Marine Fisheries Research Institute on the exploited resources as well as those obtained by the erstwhile Fisheries Project (UNDP/FAO), have indicated that there is ample scope to increase the contributions of marine fish landings from the Karnataka coast through judicious management and scientific exploitation of the resources within 50 m depth so as to obtain maximum sustainable yields (MSY) from the presently exploited resources from the traditional grounds and extending the area of exploitation for underexploited and unexploited stocks from the regions beyond 50 m depth.

As a prerequisite to assess the exploited fish stocks and to find out suitable levels of exploitation for reaping MSY, the Central Marine Fisheries Research Institute is collecting marine fish catch statistics covering catch, effort and other biological data through a scientifically designed sampling programme namely stratified multistage random sampling design; the stratification being over space and time. The data thus collected from Karnataka coast for the

past five years covering 1980 to 1984 are considered in this study. Most of these landings from near shore areas within 50 m depth. The data available from the studies made by the Palagic Fisheries Project are also considered in this paper as the same give an idea about the resources available within and beyond 50 m depth.

Present level of exploitation

The estimates of the total marine fish landings from Karnataka during 1980–84 vary from 1.12 lakh tonnes to 1.55 lakh tonnes, the minimum in 1983 and the maximum in 1982. The contribution from pelagics was maximum in 1981, the landings from this group being 1.19 lakh tonnes. Whereas during 1983 the pelagics contributed the minimum (0.60 lakh tonnes). During the five year period the percentage contribution of pelagics to the total varied from 53% to 77% (Table 1).

Among the species, Oil sardine dominates in the contribution to the Pelagics followed by mackerel and anchovies (whitebait). The landings of oil sardine were minimum in 1983 (22 thousand tonnes) and maximum in 1981 (66 thousand tonnes). This trend is evident in mackerel also, in that the minimum landings of about 2,200 were recorded in 1983 and the maximum (20,000

Table 1. Contribution of pelagic and demersal groups in Karnaraka marine fish landinds [in tonnes] during 1980–84

Groups	Years				
	1980	1981	1982	1983	1984
1. Pelagic	86,986 (75%)	118,545 (77%)	103,767 (67%)	59,738 (53%)	88,048 (69%)
2. Demersal	28,336 (25%)	34,804 (23%)	51,069 (33%)	51,860 (47%)	38,948 (31%)
Total	115,322	153,349	154,836	111,598	126,996

Table 2. The estimated annual marine fish landings [in tonnes] in Karnataka from major pelagic species

Major pelagic species	Years				
	1980	1981	1982	1983	1984
Oil sardine	42,727	65,614	55,126	21,701	36,323
Mackerel	19,634	19,766	5,511	2,182	12,334
Whitebait	5,621	5,959	11,480	10,952	11,480
Total	67,982	91,339	72,117	34,835	60,137
% in the grand total	58.95	59.56	46.58	31.21	47.35

tonnes) in 1981. The impact of this trend was felt by the over all contribution from pelagics (Table 2). The contribution from whitebait, though was relatively less, the availability of the same in large quantities, as would be seen later from the Pelagic Fisheries Project's findings, indicates the scope for increasing pelagic fish production by intensifying the exploitation of these underexploited stocks from the inshore grounds.

Among the fishing gears that exploit pelagic species off Karnataka coast at present purse seines are the most efficient and dominant. After the advent of purse-seining in Karnataka Coastal waters, the total marine fish landings in the state increased substantially. Prior to the introduction of purse seining, Rampani was the dominant gear exploiting pelagic species in Karnataka. It is quite interesting to note that during 1971–81 period Oil sardine showed wide fluctuations with maximum landings of about 66,000 tonnes in 1981 and minimum of about 12,000 tonnes in 1971 in Karnataka. In contrast, the maximum landings of mackerel in the state during this period were in 1971 (64,000 tonnes) and minimum in 1974 (9,700 tonnes). However, after the introduction of purse-seiners mackerel production touched the level of about 51,000 tonnes in 1978 and then on mackerel landings did not show any appreciable increase, inspite of considerable increase in the number of purse seiners, off Karnataka coast (Anonymous, 1982). The above observed trend in the production of the two most dominant pelagic species namely Oil sardines and mackerel in Karnataka appear to be related, to some extent, to the inherent fluctuations in their availability off this coast. However, consistently good landings of anchovies in recent years by purse seiners have indicated vast scope for increasing pelagic contribution to the total marine fish production in Karnataka (Narayana Rao, *et al*, 1982). The indiscriminate operations of purse seiners in the traditional fishing areas have resulted in the large scale destruction of juveniles of Oil sardine and mackerel and developing eggs of catfish along Karnataka coast which in the long run may affect these stocks. The magnitude of the destruction of catfish eggs from the nursery grounds off Mangalore coast by the purse seiners and its impact on these stocks have been highlighted (Silas *et al*, 1980). It is also observed, in recent years, that large quantities of prawns were landed during January–April months by purse seiners (Somasekharan Nair, *et al*, 1982).

The marine fishery off Karnataka coast at present is confined mostly to the depth zone of 0–50 m. The narrow strip of near shore areas (less than 30 m depth) is intensely exploited by almost all the gears including purse seines. At present about 300 purse seiners are in operation in Karnataka coastal waters. The total marine fish landings have reached a plateau and further contribution then could be expected from underexploited resources within 50 m depth zone and the unexploited resources beyond 50 m depth and within the EEZ. The exploratory surveys have clearly indicated a good potential for increasing production. As seen earlier pelagic fishery off Karnataka is dependent mainly on Oil sardine, mackerel and anchovies (Dhulked *et al*, 1982). There are a number of other species, notable among them are the ribbon fish, carangids and lesser sardines. Definite indications of large stocks of oil sardine, mackerel, anchovies and carangids in the depth zone 20–75 m have been shown in the recent surveys (Anonymous, 1974 a & b, 1975, 1976 a–c and 1980). A single resource which has a very high potential and concentration in the 20–50 m depth zone is the anchovies (Devidas Menon and George, 1975). The oceanic

resources such as tunas, pelagic sharks and squids and non-conventional resources such as mesopelagics dominated by myctophids and ballistids, which are abundant in oceanic waters of the EEZ, offer scope for exploitation. In the following we shall see in detail the potentials of some of these under–and un-exploited resources and how best they could be exploited to boost the marine fish production in Karnataka particularly from the pelagic stocks.

The magnitude of potential resources

Pelagic Fisheries Project during its surveys from 1972/73 to 1976/77 has estimated annual fish biomass in the west coast covering the areas from Cape Comorin to Ratnagiri Lat. (7°–17°N). The annual estimates varied widely (Table 3) with minimum in 1973/74 (8.2 lakh tonnes) and maximum in 1976/77 (42.8 lakh tonnes) with an average of 19.1 lakh tonnes. The reasons for this wide variation in the annual total biomass were believed to be associated with seasonal differences in the survival and recruitment conditions and the fact that only a few year classes are represented in the stocks (Anonymous, 1976 c & 1980). This average fish biomass was shared by whitebait, horse mackerel, shallow water mix and other fishes (Table 4). Year-wise breakup of the species-wice contributions (Table 5) indicated higher levels of biomass of whitebait and horse mackerel during 1974/75.

Table 3. Estimated yearly average total fish biomass [mt] West coast (Cape Comorin—Ratnagiri)

Fishing year	Yearly average biomass (mt) West coast (Cape–Ratnagiri)
1972/73	930,251
1973/74	816,859
1974/75	2,102,933
1975/76	1,404,814
1976/77	4,282,533
Average	1,907,478

Table 4. Estimated yearly average biomass [mt] of major pelagic fish resources of the West coast [Cape–Ratnagiri] [By echo-integration Survey)]

Name of resources	West coast (Cape–Ratnagiri)
1. Total Fish (5–y)	1,907,478
2. Whitebait (4–y)	267,864
3. Horse mackerel & Tuna (4–y)	118,082
4. Shallow watermix (2–y)	48,143
5. Other fish (4–y)	903,650

Table 5. Estimated yearly average biomass [mt] of major Pelagic fish resources on the West coast [Cape–Ratnagiri] over time

Fishing year	Yearly Average Biomass (mt)			
	Shallow-watermix	Whitebait	Horse mackerel and tuna	Other fish
1972/73	74,824	156,223	13,791	685,233
1973/74	21,463	179,665	78,490	537,241
1974/75	*	543,057	271,963	1,287,912
1975/76	*	192,513	108,087	1,104,216
1976/77	N.A.	N.A.	N.A.	N.A.
Average	48,143	267,864	118,082	903,650

*No separate estimate made, N.A. Not available.

Table 6. Estimated species-wise biomass [% wt] by minor depth domains in the West coast

Species/Groups	Depth domains				
	0–20 m	20–50 m	50–75 m	75–100 m	100–200 m
Total fish	12.6	37.1	17.2	19.1	14.0
Shallow watermix	58.4	41.1	0.3	0.2	0.0
Whitebait	11.1	76.2	10.2	2.1	0.4
Horse mackerel & Tuna	3.5	25.4	32.6	24.8	13.7
Other fish	15.1	30.5	17.2	15.8	21.4

Depth-wise distribution (Table 6) clearly indicated the maximum productive zone was in 20–50 m depth for all groups, except shallow–water mix, followed by depth zones 50–75 m, 75–100 m, 0–20 m and 100–200 m. However, heavy concentrations of shallow water mix (dominated by shallow water species like golden scad, silverbellies and glass perch) were recorded in the depth zone of 0–20 m followed by 20–50 m.

Estimates of the biomass of pelagic schooling fish by sonar surveys in the Cape Comorin–Ratnagiri area indicated 58% of them being Oil sardine followed by mackerel (28%) and others (14%); the total estimated pelagic schooling fish biomass being 9.5 lakh tonnes (Table 7). Depth-wise distribution of these species (Table 8) showed good concentration of Oil sardine (58%) and mackerel (68%) in 0–20 m depth zone whereas others, consisting mostly of horse mackerel (*Megalaspis cordyla*), scad (*Decapterus* spp.) and tuna, were found in good concentrations (70%) in the 20–200 m depth zone (Anonymous, 1974 b, 1975, 1976 c, 1980 and Narayana Rao, *et al* 1977 a).

Among the marine states bordering West cost, Kerala was reported to have major share of these pelagic resources followed by Karnataka, South Maharashtra and Goa (Table 9). Karnataka thus has good potential of the underexploited and unexploited pelagic stocks. As per these estimates 'Other fish' (comprising mostly of pomfrets, seerfish, ribbonfish, barracuda, miscellaneous clupeids, squids, sharks and rays). reported to have a share of about 2.39 lakh tonnes followed by whitebait (0.42 lakh tonnes), horse mackerel and tuna (0.21 lakh tonnes) and shallow-water mix (0.14 lakh tonnes). These estimates, excluding the share of oil

Table 7. Estimated annual average biomass [mt] of Pelagic schooling fish in the Cape Comorin–Ratnagiri area [By sonar Survey]

Name of the species	Average Annual biomass (mt)	% of total
Oil sardine	547,931	57.95
Mackerel	265,126	28.04
Others (mostly Horse mackerel/ Scad)	132,506	14.01
Total	945,563	100.00

Table 8. Depth-wise distribution of the schooling fish biomass [%wt] on the West coast [Cape–Ratnagiri]

Species	Depth Zones	
	0–20(m)	20–200(m)
Oil sardine	58.3	41.7
Mackerel	67.7	32.3
Others (mostly Horse mackerel and tuna)	28.9	71.1

Table 9. Estimated species-wise biomass [% wt] on the West coast by sub-areas

Species/Groups	Sub-areas			
	Kerala	Karnataka	Goa	South-Maharashtra
Shallow watermix	50.0	28.2	15.7	6.1
Whitebait	54.7	15.8	9.1	20.5
Ribbonfish/Catfish	43.9	20.0	15.8	20.3
Horse mackerel/Tuna	60.8	18.1	8.7	12.3
Oil sardine	73.2	19.4	3.6	3.8
Mackerel	74.4	19.4	3.0	3.2
Other fish	47.6	26.5	13.8	12.1

sardine, mackerel and ribbonfish, total to 3.17 lakh tonnes. Taking into consideration the potentials of these three resources which are in the order of 1.06 lakh tonnes, 0.51 lakh tonnes and 0.50 lakh tonnes respectively (Anonymous, 1980 and Narayana Rao, *et al*, 1977 b); the total pelagic fish biomass off Karnataka cost may roughly be about 4.8 lakh tonnes. Out of this potential, share from 0–50 m depth zone is about 50% amounting to 2.4 lakh tonnes. From this estimated potential of the presently exploited grounds the present landings take away about 40% of the stocks which is about the safe level of exploitation for obtaining sustainable yields. However, the present yield off this coast is mostly confined to 0–30 m depth zone. Hence it is high time that precautionery measures should be taken to see that the pressure of fishing effort exerted on the present stocks available in the currently exploited grounds is adjusted so as to keep these stocks in healthy conditions and by restricting any further increase in the fishing effort and by increasing the mesh sizes of the gears presently operated in the coastal waters.

Prospects for increase in production

From the estimates as seen earlier 2.4 lakh tonnes are expected to be available in the zone beyond 50 m depth. About 50% of these resources could safely be harvested without affecting these stocks. Thus about 1.2 lakh tonnes from these offshore stocks are annually available for harvest. The availability of yellowfin and bigeye tuna in good quantities during October–January months in the slope and oceanic areas between 13°N and 17°N was indicated recently by the long lining operations of PRASHIKSHANI belonging to Central Institute of Fishery Nautical Engineering and Training (Anonymous, 1985). This clearly offers scope for exploitation of Oceanic tunas in the deeper zone.

In the light of the above, the following suggestions for proper development and judicious exploitation of pelagic fishery resources off Karnataka coast may be considered:

1. Motorization of country craft may be encouraged to fish in areas in and around traditional fishing grounds and the, grounds beyond. This will help particularly the drift net fishery for the large palegic species namely seerfish, promfret, carangids, tunas, sharks etc. in the regions where their availability is established (Muthiah, 1982).

2. Redeployment of the existing purse sein fleet so that they exploit the abundant resources in the areas beyond 30 m

depth, giving much scope for traditional crafts to exploit the resources within 30 m depth zone. This would not only reduce conflicts of interests between these two sectors, but could also increase the production.

3. Extension of exploitation for anchovy resources by employing purse seines and midwater trawls in the depth zone between 30–50 m.

4. Strict regulation of mesh size, fishing seasons and areas in order to avoid indiscriminate destruction of spawners and young fish.

5. Creation of infrastructure facilities to meet the demands of the increased landings so that good price is realised for the produce.

If the above mentioned steps are taken earnestly by the fishing industry in the Karnataka coast there is enough scope for increasing the present quantum of landings to 2.5 lakh tonnes from the marine sector.

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Inshore Fishery Resources of Karnataka and the Status of their Exploitation

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ABSTRACT

Karnataka has shown appreciable progress in recent years in the development of its marine fisheries, mainly through the introduction of about 2,057 mechanised trawlers, about 370 purse seiners and about 600 mechanised gill-netters for the exploitation of the inshore fishery resources. At present, approximately 9,000 km^2 of the inshore area upto about 25 km from the shore are heavily exploited by these mechanised boats and about 9,000 non-mechanised boats, bringing in an annual average yield of 1.36 lakh tonnes (1980–81 to 1984–85). There are indications that the fast expanding fleet of fishing boats might have already caused the depletion of some of the commercial fisheries in the inshore area, as indicated by the possibly declining CPUE and the near stagnant yield in the face of increasing fishing pressure, thereby rendering the mechanised fishing operations less economical. A critical analysis of the resources and their exploitation has been made in this paper along with some suggestions for suitable management measures.

Karnataka has a fairly long coastline of about 300 km along its two maritime districts, Dakshina Kannada and Uttara Kannada. Within its 'exclusive economic zone', the State has a total fishable area of about 87,000 km^2, with an estimated fishery resources potential of about 4.25 lakh metric tonnes. Even within its continental shelf alone, the State has about 27,000 km^2 of fishable area. But unfortunately, the fishing activities at present are restricted to a narrow belt of inshore waters upto a depth 50 m only, covering in all an area of only about 9,000 km^2. This shows that even the productive fishing area along the continental shelf is itself underexploited, not to speak of the extensive fishable area in the State's exclusive economic zone. On an average about 1,36,494 tonnes of marine fish, valued at around 28 crore rupees, are being landed annually in recent years (80–81 to 84–85) from the inshore waters. The State earns about 13 crore rupees in foreign exchange through the export of approximately 3500 tonnes of seafood every year.

The annual marine landings of the State have been fluctuating between 1.0 and 1.7 lakh metric tonnes over the last few years (Table 1). In terms of quantity, the landings

Table 1. Marine fish landings in Karnataka [tonnes]

	1980–81	1981 82	1982–83	1983–84	1984–85	Average
Oil sardine	59093	72270	33882	23904	35946	45019
Mackerel	18508	18086	5003	3003	10161	10952
Prawns	9494	5349	8564	7142	8749	7859
Seer fishes	2286	1950	2084	2122	2703	2229
Silver bellies	1388	1762	2726	4382	4531	2957
Sciaenids	1816	2575	3289	4013	3413	3021
White–baits	5536	3051	8914	9437	18083	9004
Catfishes	4576	5652	4320	3735	3661	4388
Clupeoids	2287	3255	2847	5323	11649	5072
Lactarius lactarius	830	1579	1671	1908	1390	1475
Others	54889	29848	30755	39292	67760	44508
Total	160703	145377	104055	104290	168046	13494

Source: State Fisheries Department.

are dominated by the oil sardine (*Sardinella longiceps*) and the Indian mackerel (*Rastrelliger kanagurta*), while the penaeid prawns dominated in terms of value. The sardine and mackerel fisheries are subject to wide fluctuations from year to year. Even though the oil sardine and mackerel have been the mainstay of Karnataka fisheries over the years, prawns have been attracting the maximum attention since last $2\frac{1}{2}$ decades, on account of very great export demand. The introduction of purse-seiners in 1975 has not only helped to mechanise the harvesting of pelagic fish like oil sardine and mackerel but has also served to extend the effective fishing seasons to nearly 8 months in a year. Other fishes which are landed in appreciable quantities are the whitebaits and other clupeoids, catfishes, scianenids, silver bellies, seer fishes and *Lactarius lactarius*. Elasmobranches, pomfrets, ribbon fishes, tunas, perches, carangids, soles, crabs and cephalopods are also landed, but in lesser quantities.

As per the statistics provided by the State Department of Fisheries, there are about 2057 shrimp trawlers, 370 purse seiners, 600 mechanised gill netters and about 9000 indigenous crafts operating along the Karnataka coast. The number of active fishermen was 16,000 in the late fifties, and the same has now increased to about 24,900 (Table 2). The average annual catch per active fisherman is about 4.05 to 6.75 tonnes over the last few years. In the heavily exploited inshore fishing zone, the average annual catch per sq.km of exploited areas has been in the range of 11.56 to 18.67 tonnes in recent years. With the introduction of a large number of shrimp trawlers, purse seiners and mechanised gill netters, the the contribution of indigenous to total landings has decreased significantly, from more than 50% in the early seventies to less than 10% at present.

Exploitation of inshore demersal resources

Exploitation of demersal resources attracted almost the total attention of the mechanised sector from the very beginning in the late fifties till the mid-seventies, in view of the very high export potential of prawns and also their abundant availability in the inshore fishing grounds. With the encouragement recieved from the government and financial institutions, the number of shrimp

Table 2. Exploitation of inshore marine fishery resources

	Annual average 1961–62 to 1970–71	Annual average 1971–72 to 1980–81	1981–82	1982–83	1983–84	1984–85
Marine fish production (t)	95836	110769	145377	104055	104290	168046
Number of active fishermen	17423	21562	23319	23552	24211	24889
Average annual catch per active fisherman (t)	5.64	5.27	5.81	4.05	3.94	6.75
Average annual catch per sq. km of exploited area (t)	19.17	14.77	16.15	11.56	11.59	18.67
Number of indigenous boats	6000	8000	9447	9446	9082	9082
Percentage of catch by indigenous boats	70.00	49.19	14.28	12.60	11.65	7.40

Source: State Fisheries Department.

Table 3. Exploitation of inshore demersal resources by shrimp trawlers

	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84	1984–85
Number of shrimp trawlers	1450	1520	1686	1784	1833	1858	1913	1930	2057
Number of boats in operation	—	—	—	1400	1500	1500	1500	1500	1500
Catch by shrimp trawlers (t)	15108	34187	22690	31038	38956	27402	30901	34214	59099
Average annual catch per shrimp trawler (t)	10.46	22.49	13.40	22.17	25.97	18.26	20.60	22.80	39.39

Source: State Fisheries Department.

trawlers for exploiting the inshore demersal resources, mainly prawns, increased from a meager 48 boats at the end of the Second Five Year Plan to 226 by the end of the Third Plan and 1190 at the end of the Fourth Plan. Till the mid-seventies, the shrimp trawlers profitably exploited the inshore demersal resources. The number of trawlers in the State increased further to 1686 by the end of the Fifth Plan (78–79) and to 2057 by the end of the Sixth Plan (84–85). Of the latter, only about 1500 are reported to be in operation. The total landings by these shrimp trawlers since the last few years have fluctuated between 15108 and 59099 tonnes (Table 3). It can be seen therefrom that the catch has not increased in proportion to the increased efforts over the years except during 84–85. This, combined with the increased running expenditure, has rendered a large number of boats uneconomical. Considering the present situation there is an urgent need to help the sick units in the demersal sector by giving them financial assistance for equipping thier boats for diversified fishing, like gill netting and long lining. These boats are then likely to become profitable and would also help in exploiting the columnar fishery resources, where there is definite scope to intensitfy the exploitation further.

Exploitation of inshore pelagic resources

The rich pelagic resources of oil sardine and mackerel along the Karnataka coast are well known. Historically, there have been excellent landings of 60 to 80 thousand tonnes of oil sardine during certain years and 40 to 60 thousand tonnes of mackerel during certain other years. It has also been noticed that the total annual catches of oil sardine and mackerel go down to as low as 5 thousand tonnes during periods of unfavourable environmental conditions. Generally, when mackerel landings were good the oil sardine landings wree poor, and *vice versa*. The purse seine is very efficient in exploiting the shoaling pelagic resources. The objective of introducing the purse seine was to exploit the pelagic fishery resources beyond the reach of the traditional gears, but unfortunately they competed to a significant extent with the traditional gears in the inshore zone within 5 km from the shore.

The first purse seine was introduced in the State in 1975 and it became an instant success. Observing the huge profits, a large number of purse seines were introduced during the succeeding years. There were only 20 purse seines in 1976–77, and this number increased to about 300 in 1981–82. Today, there are reportedly more than 370

Table 4. Exploitation of inshore pelagic resources by purse seines

	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83	1983–84	1984–85
Number of purse seines	20	52	171	230	260	300	348	368	370
Catch by purse seines (t)	10340	30551	111788	124989	96320	97217	56799	54288	92812
Average annual catch per purse seine (t)	689.3	587.5	653.7	543.4	388.3	303.8	154.7	147.5	252.2

Source: State Fisheries Department.

purse seines in operation (Table 4.) Since the landings by purse seines have been poor during last few years, the fishermen have been put to considerable hardships. The operation of some units has become uneconomical due to reduced stock levels of oil sardine and mackerel. These units may be assisted for diversified fishing with gill nets and long lines.

Exploitation of inshore columnar resources by mechanised gill nets

The columnar resources of the inshore zone were being exploited with only indigenous boats till recently. Mechanised boats were introduced only recently for gill net fishing. There were 104 such boats in 1980–81, which number increased to 600 in 1984–85 (Table 5). The average annual catch per gill net boat has increased from about 1.28 to 7.19 tonnes over last few years. These mechanised gillnet boats are now catching about 4000 tonnes, which could be increased to about 20000 tonnes with increased level of exploitation.

Fisheries potential

Bhakta (1983) has reported that about 4.25 lakh tonnes could be exploited from the EEZ of Karnataka. This is based on estimates of yield of 8.4 tonnes per sq.km in the zone 0–40 km, 4.2 tonnes in the zone 40–160 km and 3 tonnes in the zone 160–320 km (Table 6). From this it would appear that the inshore zone is possibly fully exploited or over-exploited. The time has come to focus all our attention on the exploitation of offshore and deep sea resources. By the turn of the century, we must at least successfully harvest the fishery

Table 5. Exploitation of inshore columnar resources by mechanised gillnet boats

	1980–81	1981–82	1982–83	1983–84	1984–85
Number of mechanised gillnet boats	104	319	507	546	600
Catch by mechanised gillnet boats (t)	134	952	3241	3460	3924
Average annual catch per gillnet boat(t)	1.28	2.98	6.39	6.67	7.19

Source: State Fisheries Department.

Table 6. Fisheries potential of various zones in Karnataka

Zone	Area (sq. km)	Yield per sq. km (tonnes)	Estimated potential (tonnes)	Present	Remarks
0–40 km	12000	8.4	1,00,800	1,36,494	Fully exploited/ over exploited
40–160 km	34000	4.2	1,42,800	—	Unexploited
160–320 km	60000	3.0	1,80,000	—	Unexploited

Source: Bhakta (1983)

resources of the State's continental shelf, which has an area of about 27000 sq.km.

Taking into consideration the above mentioned facts, it is felt expedient to introduce suitable management measures. In any management regime, it is not possible to satisfy all the interested parties with diverse objectives. A fisheries manager has to take decisions with the objective of resource management, equitable distributions of the available resource and special benefits to the weaker sections of the fishermen community. The following measures are suggested for immediate consideration.

1. Labour intensive indigenous gears may be encouraged in the inshore waters, with a view to provide better employment opportunities to fishermen.

2. All encouragement and support must be given for diversified fishing, like gill netting and long lining, by the existing shrimp trawlers and purse seine boats, which are presently operating uneconomically.

3. Other than replacement of old boats, it is highly imperative not to add to the present strength of trawler and purse seine fleets in the inshore waters.

4. All boats, both mechanised and non-mechanised, may be encouraged to obtain licence from the State Fisheries Department for proper monitoring of fishing effort.

5. An efficient system may be evolved to estimate the catches from different types of boats and gear, the CPUE of selected boats and the level of exploitation of various zones.

6. Age composition of all commercially important species in the commercial catches may be studied.

7. Fishermen may be advised not to capture juveniles and not to catch fishes during their spawning season. If necessary, this could be accomplished through legislation.

8. Various zones, namely 0–5, 5–40 and 40–160 km, may be earmarked for indigenous boats, small mechnised boats and larger vessels respectively.

9. Detailed studies may be carried out on the economics of operation of all gears and socio-economic conditions of the fishermen.

10. Offshore and deep sea fishing must be encouraged through the offering of attractive incentives for achieving effect-

ive exploitation of the fishery resources of the EEZ.

11. It is advisable to enter into collaborative arrangements with advanced countries in the initial phase, both for charting the State's EEZ and its effectibe exploitation.

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Fishery Resources of the Offshore and Deep Sea Waters of Karnataka and the Fishing Effort Suggested for Exploitation

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ABSTRACT

The results of survey carried out by Fishery Survey of India since 1973 on the fishery resources of the off shore and deep waters of Karnataka are presented. The potential for exploitation of several pelagic and demersal deep sea resources has been discussed. Infrastructural fecilities required for this is also presented.

Introduction

A thorough knowledge on the availability and composition of the exploitable fishery resources is an important pre requisite for formulation of fisheries developmental programmes, regulation and expansion of fishing effort and study of economic feasibility of different type of fishing operations. With these objectives, the Fishery Survey of India has been surveying the Indian waters deploying different sizes of vessels and various fishing methods like demersal trawling, purse-seinining, tuna long lining etc. Along the Karnataka coast demersal trawl survey has been conducted during 1973–1983 with indigenously constructed 17.5 m steel trawlers and from 1983 onwards with large vessels of 36.5 m length. In addition, one Japanese aided tuna long liner and Danish aided purse-seiner were operated along this coast from the Cochin Base in recent years. The results of these surveys were discussed by various authors (Anon 1976; Joseph *et al*, 1976; Joseph, 1980, 1986; Philip *et al*, 1986). An attempt is made in this paper to give a broad picture of the fishery resources of the offshore and deep sea waters of the Karnataka and Kerala coast to plan the strategy to be adopted in respect of capture fisheries, fish processing and marketing, establishment of intrastructural facilities etc.

DEMERSAL FISHERY RESOURCES

Inshore region

The inshore area between 20–60 m have been fairly surveyed by the 17.5 m vessels during the period 1973–1983 from lat. 11°N (Cannanore) to lat. 15°N (Karwar) by

Table 1. Percentage composition of important varieties obtained by 17.5 m vessels and large vessels from 20–50 m depth range along North Kerala–Karnataka coast.

	Varieties	Percentage	
		17.5 m vessels	Large vessels
1.	Elasmobranchs	5.8	4.3
2.	Cat fishes	22.0	24.9
3.	Ribbon fishes	9.7	1.4
4.	Lactarius	3.6	—
5.	Sciaenids	1.0	—
6.	Pomfrets	1.0	—
7.	Lizard fish	1.0	3.6
8.	Carangids	8.2	17.8
9.	Silver bellies (Leiognathids)	12.0	—
10.	Nemipterids	21.0	14.4
11.	Perches	0.2	2.4
12.	Barracuda	0.4	1.4
13.	Prawns	1.0	—
14.	Cephalopods	0.7	3.0
15.	Mackerel	—	1.4
16.	Priacanthus	—	10.5

bottom trawling. The same area has been surveyed by the large vessels during 1983–1985. The percentage composition of important varieties caught by the 17.5 m vessels and large vessels is given in Table 1.

It can be seen that the catches of 17.5 m trawlers were dominated by typical shallow water varieties such as cat fishes, nemipterids, leiognathids, ribbon fishes, *Lactarius*, carangids, pomfrets, prawns etc. But in the case of large vessels, some of the shallow water varieties like pomfrets, *Lactarius*, ribbon fishes, and prawns were caught in negligible quantities while carangids, perches, cephalopods, *Priacanthus*, lizard fish etc. were more. This is mainly due to the operation of large vessels around 50 m depth. However, in both the cases cat fishes and nemipterids were the dominant varietis. It can be said that from areas upto 80 m depth the resources expected are cat fishes, nemipterids, *Priacanthus* and *Decapterus*. Another significant observation is the occurrence of mackerel in good quantities in the bottom trawl catches from 50 m and above.

Offshore and deep sea areas

The exploratory survey conducted by the large vessels along the North Kerala and Karnataka coast (Between lat. 11°N and lat. 15°N) during 1983–1985 between 50–500 m depth indicated the occurrence of presently exploited and unexploited demersal fishery resources. The percentage and catch rates of important varieties caught by these vessels are shown in Table 2. Totally about 680 tonnes fishes and prawns were recorded during this two year survey.

It can be seen from Table 2 that the varieties like nemipterids, *Centrolophus*, cat fishes, *Priacanthus*, *Decapterus* lizard fish and cephalopods (squid and cuttle fish) formed the major portion of the catch. Of these, nemipterids, lizard fish, *Decapterus*, squid and cuttle fish etc. are already exploited resources which promise further exploitation from the ofishore waters. But *Priacanthus*, *Centrolophus* deep sea prawns and lobster are unexploited resources. Depth-wise abundance and variety-wise distribution are shown in Table 3. Catch rate was comparatively high in 200–500 m with 229 Kg. per hour. This is because of the high concentration of one variety viz. *Centrolophus* sp. The next highest catch rate was recorded from the 100–200 m depth with nemipterids and *Priacanthus* as dominant varieties.

Table 2. Catch composition, catch rate and percentage of important varieties obtained by larger vessels from 20–500 m depth along North Kerala–Karnataka coast

Variety	Catch (Kgs.)	Catch/ hour (Kgs.)	Percentage
Elasmobranchs	13,952	2.81	2.03
Mackerel	7,752	1.56	1.10
Cat fishes	65,288	13.15	9.55
Caranx spp.	17,763	3.58	2.60
Decapturus sp.	45,763	9.22	6.77
Barracuda	5,237	1.05	0.76
Ribbon fishes	758	0.15	0.10
Elecate	1,634	0.33	0.20
Perches	8,792	4.77	1.30
Nemipterids	1,55,007	31.22	22.70
Lizard fish	44,770	9.02	6.60
Prawns	270	0.05	0.03
Squid and cuttle fish	28,697	5.78	4.20
Deep sea crabs	17,744	3.57	2.60
Priacanthus	61,244	12.34	8.96
Centrolophus niger	1,32,338	26.66	19.36
Deep sea prawns	14,350	2.89	2.09
Deep sea lobster	4,179	0.84	0.61
Deep sea shark	10,418	2.10	1.52
Other varieties	47,492	9.57	6.94

Table 3. Depthwise distribution of important varieties along the North Kerala–Karnataka coast

Area	Lat. 11° 00'N to 15° 00'N			
Depth range (m)	20–50	50–100	100–200	200–500
Fishing effort (hrs.)	355–33	2364.16	1442.25	802.66
Total catch (Kgs.)	43443	2,44,236	2,11,666	1,83,994
Catch/hr.	122.26	103.31	146.76	229.23
Varieties	Percentage			
Elasmobranchs	4.28	3.85	1.23	—
Cat fish	24.92	20.95	1.56	0.01
Mackerel	1.30	2.87	0.08	—
Caranx sp.	6.14	5.63	0.63	—
Decapterus sp.	11.65	14.90	2.05	—
Barracuda	1.41	0.96	1.08	—
Ribbon fish	0.01	0.26	0.05	—
Perch	2.39	2.01	1.29	0.06
Nemipterus sp.	14.40	19.70	47.52	0.02
Lizard fish	3.58	6.37	12.70	0.43
Psenes indicus	0.02	0.29	1.86	—
Prawns	—	0.11	—	—
Squid and cuttle fish	2.96	6.14	5.84	0.02
Deep sea crabs	—	0.12	8.22	0.20
Priacanthus sp	10.54	9.64	12.32	3.83
Centrolophus niger	0.02	0.35	0.39	68.87
Deep sea prawn	—	—	0.43	7.31
Deep sea lobster	—	—	—	2.27
Deep sea shark	—	—	—	5.67
Others	16.33	5.43	3.63	11.49

EXPLOITED DEMERSAL RESOURCES

The distribution and abundance of some of the groups which offer scope for further exploitation from the offshore waters are discussed below.

Nemipterids

Nemipterids popularly known as pink perch (Threadfinbream) are seen along this coast from shallow waters to 200 m depth. They are abundant in 100–200 m where the average catch rate was about 70 Kgs. forming about 48% of the total catch. The occurrence of nemipterids in the trawl catches from deeper waters along the south west coast is already reported by Silas (1969). Nemipterids were represented mainly by a single species viz. *Nepipterus japonicus*. It was caught throughout the year with peak catch rates during March–April. The dominant size range was 14–26 cms. Surveys conducted in the neighbouring areas also indicated the abundance of this variety. Being the predominant variety of shallow and deeper areas, nemipterids could be one of the prominent fishery of this coast.

Perches

Perches are mainly constituted by "Kalava" (*Epinephelus spp.*) and red snapper (*Lutianus* spp.). They contributed about 2% of the total catch of the large vessels from the southern Karnataka coast and about 13% from the northern Karnataka–Goa coast where the sea bottom is hard and uneven with rocky out crops. They are

abundant in 50 to 200 m depth belt. High catch rates of 1000–1500 kgs. per hour of epinephelids were recorded off Karwar during certain months. Prospects of development of kalava fishery off south west coast is discussed by Menon and Joseph (1969). There is scope for developing hand line fishing/bobbin trawling for perches.

Lizard fish

This group comprises the species of *Saurida* which formed about 7% of the total catch. They are abundant in 50–100 m and 100–200 m depth belts. In 100–200 m depth zone, it formed about 13% of the total catch with a catch rate of 19.0 kg. per hour. It is the second dominant variety which stands next to nemipterides among the exploited resources of the offshore region.

Carangids

Carangids were represented by the species of *Decapterus*, *Caranx*, *Carangoids*, and *Megalaspis*. Among these *Decapterus* is predominant. Carangids formed about 10% of the total catch out of which *Decapterus russelli* alone formed about 7%. They are abundant in 20–100 m depth zone. Large shoals of *Decapterus* and *Megalaspis* are observed in the ofishore waters during trawl survey.

Mackerel

One of the significant observations is the occurrence of mackerel in the demersal trawl catches in good quantities. During two years survey about 8 tonnes of mackerel was caught in the demersal trawls which formed more than one per cent of the total catch. Mackerel is found above 100 m depth with abundance in 50–100 m depth belt. The same phenomenon is reported from upper coast also (Joseph 1986, Sivaprakasam 1986).

Squid and cuttle fish

Squid and cuttle fish formed about 4% of the catch. They were abundant in 50–100 m and 100–200 m depth belts and the concentration was more along the northern part of the Karnataka coast. The average catch rate was 19.0 Kg./hour for whole Karnataka coast. Joseph (1986) reported that the chartered fishing vessels were taking sizeable quantities of squid and cuttle fish forming about 60–80% of the total catch declared by them. They have reported good catch rates viz. 106 and 76 Kgs. per hour from the North Kerala and Karnataka coast respectively. Comparatively high catch rates were obtained during August and September.

UNEXPLOITED DEEP SEA DEMERSAL RESOURCES

Priacanthids

This variety popularly known as "Bull-seye" or "Big eye" could be a potentially rich deep sea demersal resource. It is reported that this variety is commonly used as food fish in south east Asian coutries. It has been recorded from 50–300 m depth with abundance in 100–200 m depth. Ocasionally it is reported from areas below 50 m depth. *Priacanthus* formed about 9% of the catch varied from 8–29 cms. and the dominant size was 13–21 cms. The average catch rate was 12 Kgs/hr. and no significant seasonal fluctuations are noticed.

Centrolophus niger

This species, known as 'Black ruff' is one of the dominant deep sea fishes caught by the vessels. It formed about 19% of the catch caught during the period of survey and 69% of the catch recorded from the 200–500 m depth zone. It is found between 250–500 m depth zone but is very abundant in the

300–500 m depth belt. Average catch rate was 158 Kgs/hr. from 200–500 m depth zone. In certain hauls catch rates as high as 2100 Kgs/hour were recorded. This species is abundant in the North Kerala and Karnataka coast (lat. 11°N to lat. 14°N). The catch rates were more during January–February. The dominant size groups were 12–14 cm.

Chlorophthalmus spp.

Chlorophthalmus is commonly known as 'green eye'. They are found in deeper waters beyond 200 m depth zone along with black ruff. These species are also abundant in the southern Karnataka coast.

Deep sea lobster

The occurrence of deep sea lobster, *Puerulus sewelli* in large quantities along the south west coast is already established (Kurian 1965, Rao and George 1973, Oommen and Philip 1974, Oommen 1980.) Along the Karnataka coast, deep sea lobster was found in the 150–250 m depth zone. It formed about 2.5% of the total catch obtained from the 200–500 m depth belt. This species has been exploited from the south west coast of India since 1969 which fetched good export market. While processing, the recovery was about 40% headless and 20% meat by weight.

Deep sea prawns

The occurrence of deep sea prawns along the south west coast is reported by the authors mentioned elsewhere while discussing on the deep sea lobsters. Detailed accounts on the deep sea prawn resources of the south west coast are given by Joseph (1970) and Mohammed and Suseelan (1973). Along this coast, they occur in deeper water between 200–500 m depth. The average catch rate was 7 Kgs/hr. in this depth zone. Even though a number of species are located in the deeper waters only the species of genera *Heterocarpus* and *Aristeus* are of suitable sizes for commercial exploitation Earlier studies show that the recovery of these varieties while processing was 43% and 58% headless and 30% and 42% meat by weight respectively.

MEAT CHARACTERISTICS AND CONSUMER ACCEPTABILITY OF DEEP SEA FISHES

Preliminary studies on the meet characteristics of some of the common deep sea fishes like *Centrolophus*, *Priacanthus* and *Chlorophthalmus* have been conducted by the College of Fisheries, Mangalore (Dhananjaya *et al*, 1984). The proximate composition showed that all the three species are rich in proteins *Priacanthus* spp. 17.54%, *Centrolophus niger*—14.90% and *Chlorophthalmus agassizi*—14.40% and fat contents are 5.08%, 5.80% and 3.80% respectively. It is worthy to note that they are as nutritive as the common market fishes like cat fish (Protein 16.20% and fat 3.50%) and oil sardine (Protein 18.10% and fat 14.34%). Since most of these deep sea fishes are non-conventional it is very essential that suitable measures are to be taken to popularise them and promote their market acceptability. As stated earlier *Priacanthus* is largely exploited in Thailand and other south east Asian countries. While inspecting the catches of chartered vessels, it is observed that *Priacanthus* was one of the major constituents of the catch. Commercial exploitation of the deep sea resources depends on the value of these fishes and crustaceans.

PELAGIC FISHERY RESOURCES

Rich shoals of mackerel, frigate mackerel mackerel tuna (*Euthynnus affinis*) carangids etc. were located by the vessel which con-

ducted purse-seine operation from Cochin Base along this coast beyond 50 m depth. Shoals of similar varieties were sighted during the trawl surveys also. As stated elsewhere mackerel and *Decapterus* were caught in large quantities in demersal trawls from 50–100 m depth.

On the basis of acoustic and aerial surveys the occurrence of sardine and mackerel in deeper water beyond the traditional fishing zone is esatablished by the Pelagic Fishery Project, Cochin. About 6,50,000 m.t. of sardines and mackerel have been estimated from the south-west coast of India (George *et al* 1977). On the basis of the findings of Pelagic Fishery Project they have estimated 4,00,000 m.t. of anchovies, 4,20,000 m.t. of ribbon fishes and cat fishes and 1,30,000 m.t. of carangids from the South west coast.

OCEANIC RESOURCES

The results obtained by the Japanese aided vessels operated by Fishery Survey of India and Central Institute of Fisheries Nautical Engineering & Training, Cochin along the Karnataka–Goa coast recently indicate high concentrations of tuna along this coast. During 1985–86 both the vessels yielded very high catch rates from areas between 12°N to 14°N. Yellow fin tuna was predominant forming about 99% of tuna catches. The average hooking rates of tuna varied from 5.8% to 18.0%. The highest hooking rate of 41.6% for tuna was recorded during the month of February 1986. The month from October 1985 to March 1986 yielded very high hooking rates for tuna along the Karnataka coast with peak in January 1986 (Sivaprakasam and Patil 1986). These findings were confirmed by the tuna long liner operated from Mangalore on commercial basis during this period.

It is observed during the long line survey that the concentration of pelagic sharks region (latitudes 12°N–14°N) as compared to the lower latitudes. A high hooking rate of 14.66% was recorded from this area during 1984. The average hooking rate for sharks varied from 1.16% to 4.40%.

FUTURE PATTERN OF EFFORT SUGGESTED

Karnataka contributes about 10% of the total marine fish production of India, of

Table 4. The year-wise cath rates of 17.5 m vessels of Fishery Survey of India and commercial crafts operated along Karnataka coast

Year	Average catch/ hour of 17.5 m vessels of FSI (Kgs.)	Year	Average catch per commercial trawler (Tonnes)	Average catch per purse-seiner (tonnes)
1973	185.3	1976–77	10.7	333.5
1974	122.5	1977–78	23.1	500.8
1975	93.4	1978–79	14.2	860.0
1976	92.5	1979–80	17.8	886.7
1977	57.2	1980–81	21.2	388.3
1978	89.9	1981–82	14.2	303.8
1979	90.2	1982–83	16.2	154.7
1980	88.2	1983–84	17.7	147.5
1981	88.7			
1982	81.6			

which sardine and mackerel form about 50% of the landings. There are 1930 trawl ers, 368 purse seiners and 546 gill netters under operation now. All these crafts are operated in the inshore waters below 50–60m depth. The yearwise catch rates of 17.5 m vessels of the Fishery Survey of India and commercial crafts operated along the coast are shown in Table 4 which indicate that the catches are gradually decreasing/ fluctuaating in the inshore waters. As the resources like sardine, mackerel, prawns etc. of the inshore areas are over exploited, there is no further scope for increasing the effort in this area. Therefore additional production could be achieved only by extending the fishing effort beyond the traditional fishing zone. The pattern of effort suggested for this purposes are discussed below.

Extension of demersal trawling to offshore waters

As stated elsewhere the offshore areas are not exploited fully by the commercial vessels. A shelf area of about 18,000 sq. kms. is available within 50–200 m depth belt for trawling between lat. 12°N to 15°N in addition to the areas adjacent to the State. The demersal resources available in this area as discussed earlier are nemipterids, *Decapterus*, perches, lizard fish, *Priacanthus* and cephalopods. On the basis of the catch rate recorded by the large vessels about 50,000 m.t. of demersal fish stock is estimated from this area which can be exploited by introducing medium sized or larger vessels.

Exploitation of deep sea demersal resources

About 8500 sq. kms. of shelf area is available along the coast between 200–500 m depth belt. The resources are the deep sea prawns, deep sea lobster and deep sea fishes like *Priacanthus* 'black ruff' and green eye' About 12,000 m.t. of deep sea demersal resources are estimated from this region on the basis of the results of survey. Since the trawlable area is comparatively limited due to uneven and hard bottom the scope for introduction of large number of deep sea fishing vessels is limited.

Introduction of lining and extension of purse-seining

As stated elsewhere, during purse seine and trawl surveys, shoals of mackerel, carangids and mackerel tuna are located beyond 50 m. These resources can be exploited by extending the purse-seining to distant areas by introducing puse-seiners of longer endurance.

The results obtained by the tuna long liners indicate the prospects of long lining commercially. This has been substantiated by the tuna long liner being commercially operated from Mangalore.

INFRASTRUCTURE FACILITIES REQUIRED

Fishing harbour

The facilities available at present in the fishing harbours of Karnataka State are adequate for operation of large vessels. The deep sea fishing vessels earmarked for Malpe are being operated from the commecial harbour at Panambur. Even though Malpe fishing harbour is designed for deep sea fishing vessels due to silting, operation of large vessels has become difficult. The fishing harbour at Mangalore is also not suited for accommodating large trawlers. Of late, the 17.5 m vessels of the Fishery Survey of India faced a lot of navigational problems due to the sand bar and silting of the channel. Regular operation from commercial harbour may be expensive due to high port charges, non-availability of berth in time etc. The fishing harbour at Malpe and Mangalore are to be developed to accommodate deep sea vessels. The existing

facilities at Karwar can be utilised for deep sea fishing vessels.

Marketing

The prices of varieties such as nemipterids, lizard fish, perches, *Decapterus* etc. are low at Mangalore as compared to other fishing centres in the country. Wide variations are seen in the prices obtained by the Fishery Survey of India vessels at Cochin and Mangalore. In the case of deep sea varieties like *Priacanthus* black ruff, deep sea prawns, lobster etc. rates are very low. Some of these varieties are not at all accepted in the market even though they are comparable to other table fishes in quality. This is mainly due to the unfamiliarity of the public with these varieties. Efforts are to be made to fetch maximum prices to the operating agencies by way of introducing marketing system and also popularising the non-conventional fishes, to make the operation economical.

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Fishery Wealth of Karnataka: Prospects of Augmenting Production with Special Reference to Exploitation of Unconventional Resources

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ABSTRACT

The scope for augmenting the production of conventional varieties from outer shelf by introduction of vessels of 15–17 m class is discussed. The advantages of a combination trawler-cum-long liner of 34 m length and 600–650 BHP is presented. Need to improve the extension support and training and education in the relevant fields of fisheries is emphasised and the contributions of CIFNET in this area are enumerated.

Introduction

The State of Karnataka has a coastal line of about 320 km. and a continental shelf area of about 25,000 sq.km. The annual marine fish landings from the State during 1984 has been to the tune of 1.67 lakh metric tonnes which places this State fifth among the Maritime States with a production rate of 9.8 tonnes per sq.km. from the shelf area upto 50 m. depth. The details of marine fish production from different States and UTs are furnished in Table 1. Of this

Table 1. Marine Fish Production In India During 1980–84
[In tonnes]

S. No.	States/U. Ts.	1980	1981	1982	1983	1984(P)
1.	2.	3.	4.	5.	6.	7.
1.	Andhra Pradesh	116013	120538	118034	151284	146511
2.	Gujarat	207317	216740	189988	187315	286659
3.	Karnataka	164513	149955	116066	98410	167362
4.	Kerala	279021	274395	325367	385275	424718
5.	Maharashtra	400946	284850	320433	289914	321460
6.	Orissa	38700	43900	41400	47065	46984
7.	Tamil Nadu	230531	264853	214769	244360	272941
8.	West Bengal	65000	28000	31000	39000	29000
	Total States	1502041	1383231	1357057	1442623	1695535
Union Territories						
9.	Andamans	1803	1910	3879	3868	3868
10.	Goa	34954	42475	48464	50878	53711
11.	Lakshadweep	2909	3300	4201	4301	5331
12.	Pondicherry	12956	13863	13886	17641	18576
	Total U. Ts.	52622	61548	70430	76688	81486
	GRAND TOTAL:	1554663	1444779	1427487	1519411	1777021

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landings too, the pelagic resources of oil sardine, lesser sardines and mackerel formed 34% of the landings excluding which the States position is deplorably on the rear line with regards to production of conventional bottom fish resources.

The resources

Investigations in the past have indicated good pelagic resources of white baits, ribbon fish, tuna and tuna like fishes and demersal resources of cat fish, thread fin bream, Carangids, rock cods and snappers. On the continental slope, rich resources of deep sea fishes such as "the bulls eye" Priacanthus spp. the "Indian drift fish", Paenes indicus, the "black ruff" Centrolophus niger and deep sea lobster Puerulus swelli and deep sea prawns belonging the genera Aristeus and Heterocarpus. Information on the abundance and distribution of these resources beyond the inner continental shelf is presented in Table 2. Besides these, good resource potential for cepholopods has also been indicated by survey vessels from this area.

The Strategy for Harvesting

George *et al* (1977) have estimated a potential of 14,20,000 tonnes for the South-west Coast, and at, the present level of exploitation of around 6,00,000 tonnes, the remainder expected to be achieved by intensive exploitation along Karnataka and Goa Coast.

It has been observed by various authors that though there is some scope for augmenting production of conventional demersal fish resources from the inner areas of shelf upto 50 m. depth, the main thrust will have to be given to the exploitation of conventional pelagic and demersal resources of the offshore waters in the outer continental shelf and slope areas, for realising any substantial increase in the marine production. This has been substantiated by the fact that fish production from the conventional areas of inner shelf has been almost static in the recent years in spite of the addition of more mechanised vessels in this sector. In the case of Karnataka, though there had been an apparent increase in the landings of pelagic varieties with the introduction of purse-seiners, it had been mostly at the cost of landings brought by the traditional craft. It has been pointed out that any further increase in the quantum of production of

Table 2. Information on the Abundance and Distribution of Fish in the outer continental Shelf and Slope along Karnataka Coast

Varieties	Area of abundance	Average catch/hr. for Karnataka coast	Highest catch rate obtained (kg/hr.)	Percentage in total landings
Nemipterids	Lat. 11°N–Lat. 12°N	23	31.5	17
Cat fish	Lat. 12°N–Lat. 13°N	18	30	12
Carangids	Lat. 13°N–Lat. 14°N	22	16.7	7
Squids & Cuttle fish	Lat. 14°N–Lat. 15°N	4	3.7	1.6
Tuna	Lat. 13°N–Lat. 14°N	13.5%*	43.3%*	87.9
Priacanthus spp.	Lat. 10°N–Lat. 11°N	18	72.4	12
Centrolophus niger	Lat. 11°N–Lat. 12°N	158	52.8	68.9
Paenes indicus	Lat. 11°N–Lat. 12°N	2	30.0	6.2
Deep sea prawn	Lat. 11°N–Lat. 12°N	15.0	7.06	2.39
Deep sea lobster	Lat. 12°N–Lat. 13°N	7.1	3.26	1.06

*hooking rate

pelagic fish of the conventional type, i.e. oil sardine, mackerel, lesser sardine etc. have to be achieved from the outer continental shelf, as the entire stock of these varieties does not come to the traditional fishing grounds of the inner shelf.

The forward looking enterprising fishermen of Karnataka are always ready to accept change, as can be seen from the smooth and successful introduction of purse-seiners as the second generation craft from the small mechanised boats. Thus it may not be impossible for the State to further progress with this transition process by introducing a new generation of trawlers of larger size range and purse-seiners for harvesting the fishery wealth of the State beyond 50 m. depth. Once a new generation of 15–17 m. class of trawlers get stabilized in their operation, efforts by purse-seines to refit themselves for trawling during lean season might also follow.

Bsides introducing vessels of suitable size and power it is imperative that improved types of gears should also be introduced for optimum results. The results achived by CIFNET through the popularisation of high opening bottom trawls along Gujarat Coast and trial operation of box trawls along Kerala coast have proven that these gears are superior to the traditional trawls operated in these areas. It is also thought that an extension programme of the high opening bottom trawl among the existing mechanised boats of the State itself could bring in a sea change in their landings.

One major factor distracting the existing mechanised boats from harvesting fish and drifting towards shell fish fishery is the poor economic returns obtained from fish catches landed by them. A strong internal marketing net work and a capable 'refrigerated wharehousing' in the public sector in addition to increased dried, canned and other types of processed outputs will take care of the glut situation and exploitation by middle men and ensure the fishermen of better and steady returns for their fish catches.

Improving the fish production by harvesting more of the conventional varieties both from within and outside the traditional fishing limits thus seems to be within the easy reach of the State which very well can be achieved through a short range programme. However, attention is to be focussed on the main bulk of untapped rsources of conventional varieties simulataneously and strategies for harvesting the same should be drawn without any wastage of time. This project is much more capital intensive compared to the short range programme mentioned earlier and needs enough technological support in addition to the higher proportion of funds involved. Nevertheless this programme has to be translated into action within the shortest span of time. One of the aims of this paper is to make some inroads into the present level of knowledge on the viability of a fishery of unconventional marine resources of the State.

The term 'unconventional resources' is used here to refer to (i) those items of resources within the traditional fishing area which are at present harvested in nominal quantities as bye-catches or are neglected for several reasons such as cephalopodes and (ii) those which are beyond the traditional fishing grounds and as such are quite new to the catching industry such as the deep sea fishes, deep sea prawns and deep sea lobsters. (iii) Tunas and tuna like fishes and oceanic sharks which form yet another group are not unfamiliar to the fishermen but are less accessable to him due to the paucity of adequate craft, gear and techno-

logy though these are established to fetch attractive economic returns.

Experience of CIFNET

The 34 M. combination vessel Prashikshani had undertaken tuna long line operations from 1983. The results of the operations of Prashikshani are discussed below:

Of 28 square of 3600 sq. miles each surveyed since Jan. 1985,the correct fishing grounds were located only in Nov. 85, off Karnataka in the areas of 12–72, 13–72, 13–73 & 14–72. Yellowfin tuna (**Thunnus albacore**) constituted 87.9% of the catch from these grounds with an average hooking rate of 13.5% for the entire period of Oct. 85 to May 86. The highest hooking rate obtained for the species was 43.3% during the month of Feb. 86. The highest per day catch amounted to 202 pieces obtained in Dec. 85. The weight of single specimen ranged between 30–40 kg. Hooks per basket had to be changed from 5 to 3 as baskets of tuna long-lines were lost due to excessive weight, caused by unparalleled hooking rate. Other species caught from this area were skipjack, black marlin, blue marlin, Indian sail fish and sword fish.

These highly productive tuna fishing grounds along the sea off Karnataka offers very great opportunity for Karnataka to build up a tuna long-liner fleet without loss of time. The proximity of Karnataka ports like Mangalore and Karwar to the newly located fertile tuna grounds is the very strong point for entrepreneurs in Karnataka to go in for tuna long-lining.

Another plus point of the State is a plentiful supply of sardine, mackerel, nemipterides, carangids and squids, which are the baits best suited for tuna long line fishery.

Craft for oceanic and deep sea operations

Thus a project intended to harvesting these unvonventional resources should speak of the craft first. The craft needed for harvesting the oceanic resources of tunas, bill fishes and shark has to be a long-liner with adequate endurance, fittings for high sea navigation and installed freezing and frozen storage capacity. The craft needed for the exploitation of the deep sea fish and shell fish resources is a suitable stern trawler with trawl-winch specially designed for greater pulling power and warp capacity.

As the tuna fishery off Karnataka coast has been found to be seasonal, and prospects of hunting for tuna in the equatorial waters and in the Bay of Bengal during lean seasons is beyond the scope of the present paper, a combination vessel with facilities for long lining and trawling is thought to be the best suited for harvesting the oceanic tuna and deep sea resources available off Karnataka Coast.

The salient features of this vessel Prashikshani operated by CIFNET in the area and results of her operations with cost elements is furnished here briefly for the benefits of policy planners/Public sector undertakings/Private enterpreneurs.

The vessel is of all steel construction with an OAL of 34 M. and beam of 7.6 M. and draft of 2.8 M. and with 220 GRT. The vessel is fitted with Yanmar diesel engine of 750 BHP. The stern is transom with ramp and the aft deck is free with the trawl winch located to the aft of the wheel house. The line hauler is fitted on the main deck midship towards the starboard gunwale. One freezer tunnel with a capacity of 3 tonnes/day and two refrigerated cargo hold of 25 tonnes at –20°C and 17 tonnes at 0°C capacity respectively are below the main deck to the aft of engine room and a refrigerated bait hold with –20°C is located closer to the stern ramp on the port side

Table 3. Technical Specifications and other Details of M. V. Prashikshani

I. Principal Dimensions

LOA (M)	—	34
Beam	—	7.6 M.
Draft (mld)	—	2.8 M.
GRT	—	212
Year built	—	1980
Place built	—	Japan

II. Engines & Generators

Main engine	—	Yanmar Diesel
BHP	—	750
Average fuel consumption	—	100 litres/hr.
Auxiliary engines	—	two nos. make: Yanmar HP: 125 BHP

III. Capacities

Fuel oil	—	49 tonnes
Fresh water	—	40 tonnes
Freezer hold	—	25 tonnes at –20°C
Cargo hold	—	17 tonnes at 0°C
Blast freezer	—	–30°C. cap. 3 tonnes/ day

IV. Fish detection equipment

Fish Finder	—	2 Nos. FURUNO FE–0–6IU 50 KHZ and 200 KHZ
Net recorder	—	FURUNO –F.H. 103
Sonar	—	FURUNO H. H. –103
Electronic water temperature recorder	—	Electronic with recorder

V. Navigational equipment

Radar	—	FURUNO FR–1011
Direction Finder	—	FURUNO FDR
Satelite Navigator	—	SIMRAD
Radio telephone	—	SKANTI
Auto pilot	—	—

VI. Deck eqipment

Trawl winch	—	Two drum type—Hydraulic wire rope capacity 850 M. *S*f 18 mm wire rope heavingspeed 50 m/minute at half drum
fishing net	—	2 Nos.
Line hauler	—	Hydraulic
Hydrographic winch	—	Electric with counter
Windlass	—	Hydraulic

VII. General

Free running speed	—	10 knots
Crew accommodation	—	21 bunks
Laboratory	—	wet type
Endurance	—	20 days.

below the main deck. Other technical specifications of the vessel is furnished in Table 3. The profile and deck lay-out of the vessel are given in Fig. 1 & 2.

Since her commissioning, the vessel has been put to intensive fishing operations with bottom trawls, pelagic trawls and long lines. More than 75% of the fishing exercise was with long-lines with intention to develop this technology, especially under the guidance of the Japanese longline expert Capt. E. Haruta during Sept. 1983–Feb. 1985. Distance-wise this vessel was deployed for operations upto 5° South of equator, around Andaman seas and on western sides of Lakshadweep basing her at Cochin, and has been found to possess excellent sea-worthy characters.

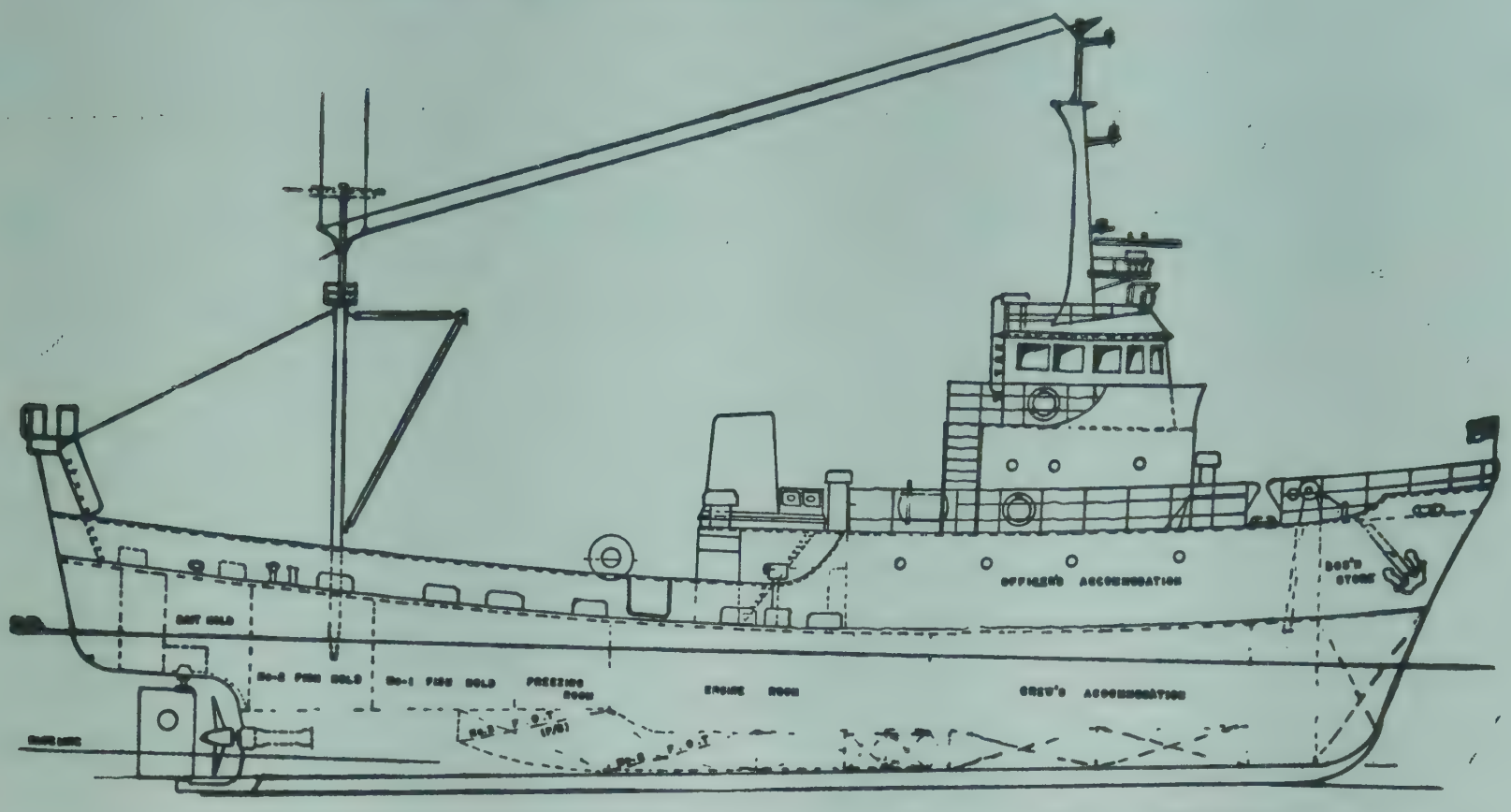

Fig-1 M V PRASHIKSHANI Profile

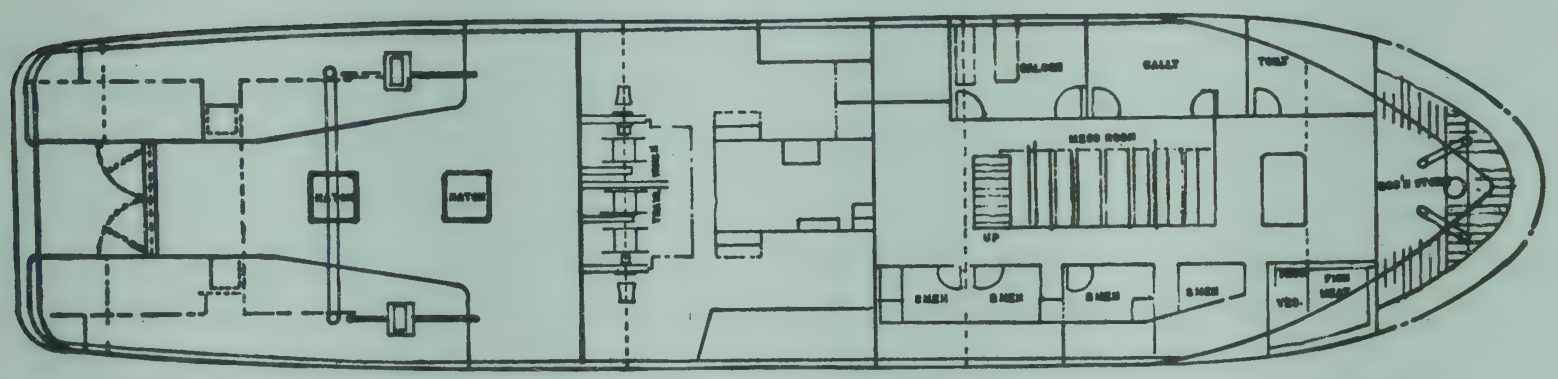

Fig-2 M.V. PRASHIKSHANI Uper deck

The area-wise details of effort and catch by the vessel from the waters off Karnataka using long lines are furnished in Table 4.

It has been observed that the catch rates obtained by the vessel are readily comparable with that of the Japanese long liner

Table 4. Details of effort and catch of M. V. Parashikshani off Karnataka Coast during October 1985–April 1986 by long lining

Month	Area fished	No. of hooks operated	No. of fishes caught (hooking rate)	
			Yellowfin tuna	Total
Oct. 85	12–72, 13–72 14–71, 14–72	8120	369 (4.5)	458 (5.8)
Nov.	13–72, 14–72 15–71, 15–72	5600	607 (10.8)	719 (12.84)
Dec.	14–71, 14–72 15–71, 15–72	5650	851 (15.1)	940 (16.6)
Jan. 86	13–72, 14–72	2765	694 (25.09)	709 (25.6)
Feb.	13–72, 14–72	3252	853 (26.7)	928 (28.6)
March	12–73, 14–72	4260	919 (21.6)	957 (22.5)
April	13–72, 14–72	3780	791 (21.5)	880 (23.3)
May	13–72, 13–73 14–72	6990	391 (5.9)	641 (9.2)

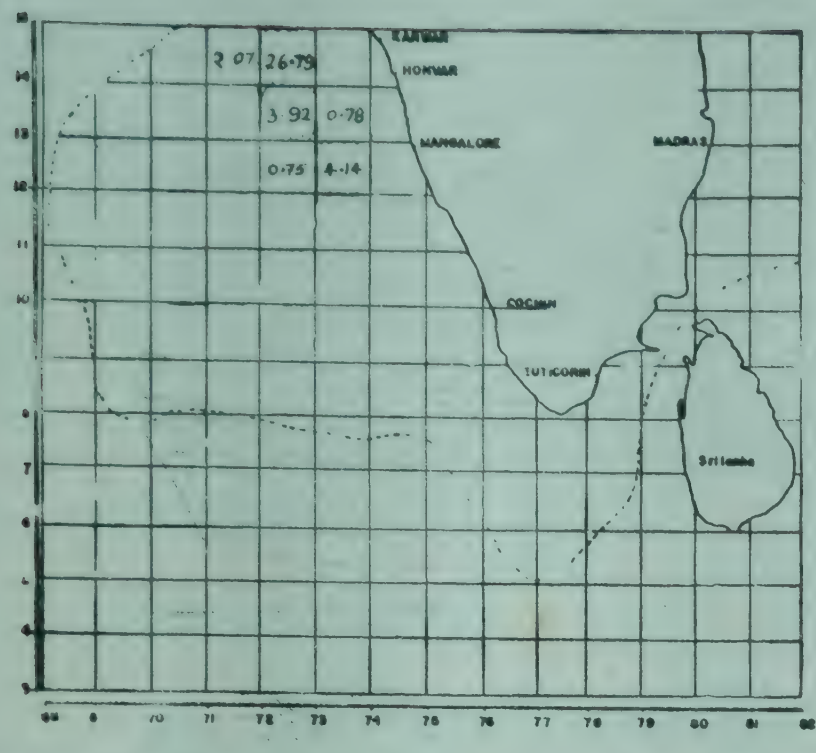

Fig 3. Distribution of sampling effort (Hooks × 1000) during October 1985 to May 1986. *by* M. V. Prashikshani

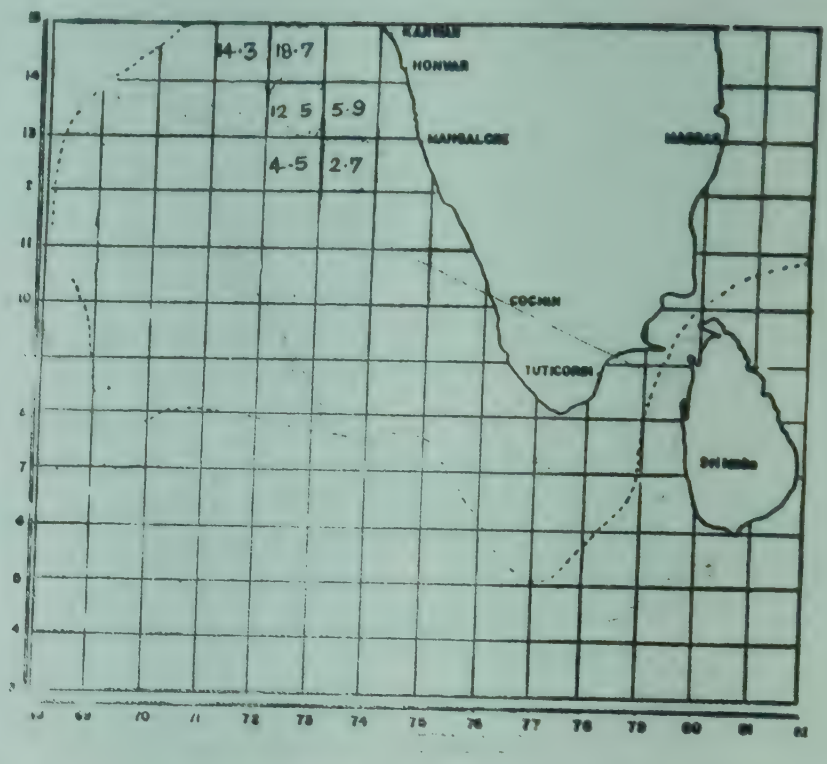

Fig 4. Hooking rate (%) obtained for tunas, bill fishes and shark. *by* M. V. Prashikshani during October 1985 to May 1986.

Matsya Sugandhi operated by FSI in the same areas during the above period. The details of effort expended and hooking rate (%) obtained by the vessel during October '85–May '86 is furnished in figures 3 and 4.

A comparison of the hooking rates obtained by Prashikshani with the Japanese commercial long liner operated off Tasmania for blue Fin tuna presented in Table 5 also confirms that the operational efficiency of Prashikshani as a long liner is much in the commercial scales. This removes the existing apprehension that combination vessels are inferior to vessels designed for single method of operation.

Table 5. Comparison of catch and effort data of M. V. Prashikshani with that of Commercial Japanese Long-Liners
Catch and effort data for Japanese Long Liners in the AFZ off Tasmania, May–Aug. 1984, 6 days fishing

Month	No. of vessels	Total catch (tonnes)	Blue fin catch (tonnes)	Blue fin Numbers	Effort (hooks ×1000)	Total catch rate (kg/1000 hooks)	Blue fin Catch rate (number/ 1000 hooks)
May 84	4	11.5	11.1	89	45	256	2.0
June	17	195.5	179.3	2631	520	378	5.1
July	16	281.1	268.2	4123	950	296	4.3
Aug.	3	37.3	37.3	572	132	282	4.3

Catch and effort data for M. V. Prashikshani Tuna long liner of CIFNET in the EEZ off West Coast [Karnataka Coast] Oct. 85 to Jan. 86

Month	Total catch (tonnes)	Yellow-fin tuna catch (tonnes)	Yellow-fin numbers	Effort (hooks)	Total catch rate (kg/1000 hooks)	Yellow-fin catch rate (number/ 1000 hooks
Oct. 85	12.244	9.842	365	8120	1211	44.9
Nov.	17.534	14.878	607	5600	2657	108.4
Dec.	20.966	18.771	851	5650	3322	150.6
Jan. 86	21.330	20.820	694	2765	7529	250.9

Economics of operation

From the inputs and returns in tuna fishery off Karnataka coast a projection of the economics of operation of a similar vessel in the commercial scale is attempted below:

I. Capital cost		**In Rs.**
(*i*)	Vessel (approaximate)	1,20,00,000
(*ii*)	Long line gear (300 baskets with 5 hooks)	3,00,000
(*iii*)	Trawl gear (5 nets and 2 pair otter boards)	1,20,000
		1,24,20,000

II. Operational cost (per annum)		
(*i*)	Fuel oil and lubricants	16,15,000
(*ii*)	Baits (2 tonnes per month ×8 months @4000 per tonne)	64,000
(*iii*)	Crew salary	3,10,000
(*iv*)	Incentive to crew (at 5% of sale proceeds)	3,90,000
(*v*)	Stores and incidentals (12000 ×12)	1,44,000
(*vi*)	Running repairs (2000 ×12)	24,000
(*vii*)	Berthing and other port charges (5000 ×12)	60,000
(*viii*)	Depreciation at 8.5% on the vessel	10,20,000
(*ix*)	Depreciation on gear at 50%	2,10,000
(*x*)	Interest on capital at 15%	18,63,000
(*xi*)	Annual dry-docking expenses	3,00,000
	Total expenditure:	60,00,000

III. Returns		
(*i*)	Value of 700 tonnes of tuna @10,000 per tonne	70,00,000
(*ii*)	Value of trawl catches and fishes other than tuna caught on long lines @4000 for 200 tones	8,00,000
		78,00,000
	Net profit	18,00,000

It has been found possible for the vessel to operate upto 1000 hooks per setting. Information on the chartered long-liners operating in the area points to that daily two settings are possible with one in the early morning and a second one in the evening. Daily catches as high as 600 pieces of Yellow-fin tuna is known to have been taken from this ground by commercial vessels. Therefore the estimate of 5 tonnes per day after giving due allowance to possible poor catches during the beginning months of September–October and concluding months of May–June could still be on the lower side.

As mentioned already the tuna season is found to be active from October to April in this region. The effort of the vessel during the remaining months is to be diverted to harvesting the unconventional resources on the outer shelf and on the slope. No economic projection has been attempted for these varieties as the price structures for all these varieties except for cephalopodes is handy. However, results obtained by Govt. of India survey vessels pertains to a possible catch of upto 5 tonnes of these varieties.

Till the fishery for the unconventional resources get stabilized, the vessel can exploit the white baits, cephalopods and perches from the Wadge bank/Gulf of mannar during the months of South-west Monsoon.

Experience with the operation of M. V. Prashikshani has undoubtedly proven that

it is very efficient as a long liner and trawler suitable for commercial operations. The combination facilities has not led to sacrificeing the fishing efficiency with either of the gears. The trawl winch with a pulling power of 7 tonnes and wire capacity of 850 M. of 18 mm dia steel wire rope could easily trawl upto slope. The stern ramp, trawl eye and a host of other devices as listed in the Table 2 makes it an efficient trawler for operating pelagic, midwater or deep sea trawls. The position of the line hauler midship as a deviation from the conventional longliner, when it is far forward in position had raised certain doubts earlier as regards to its efficiency as a long liner. But intensive operation carried out in the past has proved it beyond doubt that the vessel is as efficient as any other long-liner.

As described in the foregoing, the vessel of M. V. Prashikshani's type is thought to be best suited for harvesting the offshore tuna resources and deep sea wealth of the Karnataka region. As the lay out, drawings and constructional details are already available with Govt. of India, time spent in deciding the vessel type for ordering can be saved. However, the following slight modifications in the existing design are found necessary for this type of vessel to be more efficient in operations on a commercial scale:

1. The 750 h.p. engine fitted on board at present is found to be slightly on the higher side. A 600–650 BHP engine would be sufficient for the vessel. Considering the proximity of the fishing ground and normal power equipment, a reduction in fuel expenses by a fuel efficient low power engine would add to better returns.

2. The freezing capacity and frozen storage capacity of the vessel has been found inadequate with reference to the endurance of the vessel. A freezing capacity of 6 tonnes per day and frozen storage capacity upto 50–60 tonnes at –50°C would be required for permitting a voyage of 15 days duration. This can be achieved by reducing and rearranging the accommodation space below deck.

3. Number of crew accommodation can be reduced. For commercial operation a crew of 14 would be sufficient as suggested below:

Crew line-up

Skipper	—	1
Mate/Bosun	—	1
Chief Engineer	—	1
II Engineer	—	1
Greaser	—	1
Cook	—	1
Deckhands	—	8
		14

Accordingly the capacities of the fuel/fresh water tanks and living accommodation could be reduced which will permit increasing storage space.

4. Capacity of auxiliary engines will have to be augmented to provide –50°C refrigeration and freezing capacity of 6 tonnes/day.

Gear for long lining is posing a problem in the country. Though best quality gear is available for import from countries like Japan and Korea, indigenous technology for developing synthetics and hardware required for the gear has to be developed. Attention of the Govt. has already been drawn to this area and it is hoped that this hurdle will be overcome in the near future, as many of the manufacturers are also showing positive response.

The State Govt. should provide a frozen storage of 100 tonnes at –50°C at Mangalore/

Karwar to facilitate immediate storage after landing by the vessel.

II

Another objective of the present paper is to focus attention on the technological needs and extension back up required by the marine fisheries sector of Karnataka and the contribution that can be made by CIFNET in this regard. As Knud Muller, Adviser, Indo-Danish Fisheries Project, Tadri has rightly put it, extension back up, education and training are the essential pre-requisites for accelerating the fisheries development and ameleorating socio-economic backwardness of the fishermen. These deficiencies which he has identified for north Kanara applies for the whole of coastal Karnataka as well. Much work on the fish processing technology for gaining consumer acceptance for the new resources of deep sea fishes, deep sea prawns and deep sea lobsters and introducing new processed formulations such as fish protein isolates and other edible products has to be done. Institutions such as the Fishery College, Food Technological Institutions etc. within the State are capable of tackling this problem. Equipping a Deep sea fishing harbour on Karanataka Coast in the lines of Vishakapatnam fishing harbour on the east coast would be another priority task. Other infrastructural facilities required are a frozen goods terminal in the Mangalore harbour and starting internal marketing net work in the Public sector. It is equally essential that a package programme for extension, education and training is prepared by the policy planners for the Seventh Plan.

Facilities available with CIFNET

The CIFNET can participate in the fishery developmental activities of the State in the following fields:

(i) Organising field demonstration of the operation and fabrication of high opening bottom trawls of BOBP design for the vessels upto 10 m. in order to improve production from traditional fishing grounds.

(ii) Providing technical know-how in the fabrication of trawls suitable for second generation trawlers of 15–17 m. length proposed for harvesting the resources of outer continental shelf.

(iii) Imparting technology of Kort Nozzle for smaller crafts to achive fuel economy.

(iv) Providing technical information on ferro-cement boat building technology.

(v) Providing practical training on operation and construction of tuna long-lines and handling of catch on board.

(vi) Conducting short term training courses for teachers for Fishermen Training Centres, Fishery Extension Officers, Fishing Gear Technologists, Shore Machanics and Radio telephone operators.

(vii) An estimation of the certificated personnel for manning the future vessels of the Public sector enterprises of the State is called for Training facilities in the MFVC and EDFVC run by the Institutes can be provided.

Conclusion

The waters off Karnataka is rich in conventional resources beyond the traditional fishing limit of about 50 m. depth and unconventional resources of cephalopods, deep sea fishes, deep sea prawns, deep sea lobsters and oceanic tuna and bill fishes. While there is only limited scope of improving production from the traditional fishing grounds, much scope exists for augmenting production of conventional varieties from the outer shelf by introducing a next generation of

15–17 m. class. The signs of positive entrepreneurship of the fishermen and availability of the technical know-how indicates that it is possible for the State to achive this through short range specific programmes.

One such specific programme shall be the introduction of combination vessels for tuna long-lining and trawling immediately. A combination trawler-cum-long liner of 34 m. length and 600–650 BHP is produced as the ideal vessel type for this purpose. This programme though highly capital intensive, has to be commissioned at the earliest.

The Technological back up required for establishing new fishery products of the deep sea variety is available with the State, while an established export market for tuna and shark fins already exist within the country. The project appears economically feasible from the financial projections made from the results of operation of the Trawler cum liner operated by CIFNET.

A strong internal marketing system to cater the far interior places of the country should be set up by the State. This will help gaining consumer acceptance for the non-conventional fishery resources to be harvested by the State. This is a programme which will not only prove economical but also attract more fishermen towards catching fishes thereby adding to the per capita fish protein availability to the masses.

Need to improve the extension support and training and education in the relevant fields of fisheries is emphasized. The contributions that CIFNET can make in this regard are enumerated.

In short there seems to be excellent climate poised for a big take off in the marine fisheries sector especially with the IDFP to guide and channelise the development. It is hoped that proper planning and effective implementation of the plans would soon usher in an area of development in the field of marine fisheries in the State of Karnataka.

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Exploited Pelagic Fish Resources of the Mangalore Area--An Appraisal

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ABSTRACT

Pelagic fish resources of the Mangalore area 1970 through 1984 have been studied with reference to the catches of different gears. During the period, a marked change in the pattern of fishing operattions took place resulting in the tapping of the hitherto underexploited resources, viz., anchovies, tunas, cat fishes, carangids, etc. During the early seventies, the catches were accounted for exclusively by indigenous gears operated in inshore waters. In the late seventies, the fishing pattern underwent a sea-change with the large-scale introduction of purse seines. As a result, there was a steep rise in the landings of commercial pelagics, viz., mackerel and oil sardine. This phenomenon continued till 1982. Though the artisanal fishermen initially resented the introduction of purse seines because of the fact that this made most of the traditional gears obsolete, later the change-over became smooth partly due to the financial support given by scheduled banks. The gear accounted for a good part of the marine fish landings of Karnataka State and hence became more effective for the exploitation of pelagic fish resources.

The drift gill net is the only indigenous gear which is still being used extensively by the traditional fishermen. This is very effective for the exploitation of larger pelagics, viz., seer fishes, tunas, pomfrets, cat fishes, sharks, etc. Lately, because of good returns, there is a gradual increase in the motorization of the canoes.

Introduction

Karnataka State with a 300 km long coast and about 25000 sq.km. of continental shelf area adjoining two districts, vis., Dakshina Kannada and Uttara Kannada produces annually 112597 tonnes of marine fishes (1970–'82 average) forming 8.85% of the total marine fish catch of India (12.40% of the fish landings of the west coast of India).

The marine fish production of the State comprise predominantly the pelagic resources, mackerel and oil sardine. During the early seventies, the landings were acounted for exclusively by indigenoues gears, viz., Rampani, small shore seins, cast nets and gill nets. In the late seventies, the fishing pattern underwent a major change with the large-scale introduction of purse seines. With a mere 2 purse seiners in 1975–76, the number rose to 20 in 1976–77, 50 in 1977–78 and still higher in the following years. As a result of the diversification of fishing through crafts and gears, there was not only a steep rise in the catches of the conventional resources but also some of the hitherto underexploited resources such as anchovies, tunas, cat fishes, carangids, etc.

Although Dakshina Kannada District has a coastal stretch of about 125 km, it accounts for a major part of the State's marine fish catches (70.8% in 1977 and 80.9% in 1978–Jacob *et al*, 1979). The fishing area of the district can be divided into 3 zones, viz., Mangalore, Malpe and Gangolli. A multiplicity of gears are operated in these zones. Of these, the Mangalore zone, comprising the centres Ullal, Bunder (Mangalore) and Baikampady, ranks first in marine production. At Ullal and Baikampady, pelagic fish catches are brought in exclusively by indigenous gears. At Bunder, both indigenous and mechanised units land the catches. The

pelagic fish landings of the Mangalore zone made up 19.0–28.6% of 'all fish' catch of the State during 1978–82. This was largely due to large scale introduction of purse seines from 1976–77 onwards and improved infrastructural facilities available at Mangalore.

Among the indigenous gears, shore seins (Rampani, Kairampani and Maribale) accounted for the bulk of the pelagic fish catches followed by drift gill net (Odubale), gill nets (Pattabale, Kanthabale, Mangibale, Chalabale, Bolingerbale, Kollibale and Manangubale) and cast net (Beesubale). The giant shore seine, Rampani was operated more often at Baikampady than at Ullal.

Exploited pelagic fish resources

The paper presents the operational results of different gears in the Mangalore zone 1970 through 1984. To understand the resource position better, the period is divided into three phases, viz., one (1970–76) when pelagic fish landings were accounted for only by indigenous gears, two (1977–79) the transitional stage when purse seins were being introduced on a commercial scale and three (1980–84) when purse seiners dominated the fishing scene.

As already stated, prior to the introduction of purse seines in the Mangalore area, pelagic fish were landed mainly by indigenous gears operated at Ullal and Baikampady. At Bunder, Mangalore only after the introduction of purse seines (in 1976) pelagic fish were landed in large quantities. Till then, demersal fish constituted the major catch landed by mechanised boats operating trawls.

The particulars of effort expended and total catch of pelagic fish landed at Mangalore, Baikampady and Ullal are given in Table 1. It is seen that during the first phase (1970–76) when the catches were accounted for only by indigenous gears, the total landings in the Mangalore area varied between 516.50 tonnes in 1973 and 1495.73 tonnes in 1970 with the annual average at 800.00 tonnes for the period. In the second phase (1977–79) when purse seines were being introduced on a large scale, the catches registered a steep rise. The landings rose from 9725.4 tonnes in 1977 to 28982.96 tonnes in the following year. In 1979, the landings declined marginally to 25372.20 tonnes. The average catch in the second phase stood at 21360 tonnes. In the third phase (1980–84) when purse seine was the principal gear operating in the fishery, the total catch was 28796.48 tonnes in 1980. The annual landings crossed the all-time high 38000 tonnes in 1981 and 1982 when they formed 25% of the total marine fish catch of the state. However, the landings declined to 16189.20 tonnes in 1983 mainly due to the failure of the major fisheries, oil sardine and mackerel. These declined by 73% and 61% respectively over those of 1982. Neverthless, the total catch picked up to the extent of 26148.04 tonnes in 1984 but far from the levels attained in 1981 and 1982. This was due to the continued decline of oil sardine landings. But, the mackerel fishery attained in 1984 more or less its 1980–82 level of exploitation. The average annual catch in the third phase stood at 29712.00 tonnes.

If the average annual catch during the three phases of the period under study are considered, it will be seen that the rise from first to second phase was 27.67–fold, second to third 1.4–fold and from first to last 37.14–fold. The rise in the landings was phenomenal in the second phase (i.e., pre-purse seine to the transitional purse sein era). Overall, the third phase (1980–84) which witnessed the height of purse seine operations in the Mangalore zone registered a

steep rise in the landings over those of indigenous gears (pre-purse seine) era. Further, if the annual average catch of 26580.08 tonnes of the purse seine era (1977–84) is compared with that (799.56 tonnes) of the indigenous gears era (1970–76), it will be seen that purse seine operations brought 33.24 times more returns to the fishermen.

Gear-wise production

The average annual effort, catch and catch per unit effort (cpue) of different gears during the first, second and third phases of the period 1970–84 at Mangalore, Baikampady and Ullal are given below:

Mangalore

	Effort (Units)	Catch (tonnes)	cpue (tonnes)
Purse seines			
Phase 1	NOT-OPERATED		
Phase 2	7759	21016	2.71
Phase 3	15154	29304	1.93
Drift gill nets			
Phase 1		No Data	
Phase 2		No Data	
Phase 3	4915	332	0.07

Baikampady

Shore seines			
Phase 1	125	552	4.42
Phase 2	86	242	2.81
Phase 3	125	63	0.50
Gill nets			
Phase 1	333	15	0.05
Phase 2	757	26	0.03
Phase 3	455	15	0.03
Cast nets			
Phase 1	449	9	0.02
Phase 2	534	17	0.03
Phase 3	742	17	0.02

Ullal

	Effort (units)	Catch (tonnes)	cpue (tonnes)
Shore seines			
Phase 1	19	0.35	0.02
Phase 2		Not operated	
Phase 2		Not operated	
Gill nets			
Phase 1	5178	139	0.03
Phase 2	2498	51	0.02
Phase 3	1630	23	0.01
Drift gill nets			
Phase 1	1320	57	0.04
Phase 2		Not operated	
Phase 3	6	0.07	0'01
Cast nets			
Phase 1	1208	26	0.02
Phase 2	358	9	0.03
Phase 3	199	4	0.02

It is seen that the shore seine catches at Baikampady and gill net catches at Ullal declined gradually after the first phase (indigenous gears era) reaching lowest in the last phase (when purse seines dominated the fishing operations) at Mangalore. Probably, this is due to the pressure exerted on the resources by intense purse seining.

The particulars of effort, catch and per unit effort of Rampani at Baikampady 1970 through 1984 are as under:

Year	Effort (Units)	Catch (tonnes)	cpue (tonnes)
1970	94	1175.272	12.502
1971	94	534.806	5.630
1972	124	474.280	3.820
1973	97	208.416	2.148
1974	44	295.705	6.720

Year	Effort (units)	Catch (tonnes)	cpue (tonnes)
1975	61	596.250	9.774
1976	87	519.105	5.966
1977	135	523.618	3.878
1978	50	181.263	3.625
1979	14	9.490	0.577
1980	46	28.047	0.609
1981	143	78.151	0.546
1982	45	25.647	0.574
1983		No data	
1984		No data	

As can be seen, the cpue of Rampani units declined precipitously from 1977 onwards when purse seine passed from the second (transitional) to the third phase (dominant). The situation forced the fishermen to abandon the important traditional gear, Rampani.

The study of the pelagic fish resources of the Mangalore area during 1970–84 revealed that by and large purse seines accounted for 96.03% of the pelagic fish catches followed by shore seines (2.19%), drift gill nets (0.04%), gill nets (0.65%) and cast nets (0.18%).

At Bunder, Mangalore purse seines made up 99.21% of the pelagics (211241.52 tonnes) followed by drift gill nets 1977 through 1984. The bulk (62.98%) of the catch comprised oil sardine. This was followed by mackerel (18.19%), anchovies (10.51%), carangids (2.26%), lesser sardines (2.06%), tunas (1.47%) and other fishes.

At Baikampady, shore seines (mainly Rampani) brought in a major part (92.40%) of the landings (5174.14 tonnes) followed by gill nets and cast nets 1970 through 1982. The catches of Rampani mainly comprised oil sardine (46.71%) and mackerel (45.05%). Gill net landings were also made up predominantly of mackerel (45.62%) and oil sardine (36.52%). The landings of cast nets were composed predominantly of oil sardine (86.47%).

At Ullal, 1970 through 1982, gill nets accounted for a good part (65.76%) of the pelagic fish landings (1821.88 tonnes) followed by the drift gill nets (22.00%), cast nets (12.10%) and shore seines (0.14%). The landings of gill nets were made up predominantly of oil sardine (68.60%) and mackerel (12.93%). Drift gill net landings of pelagic fish mainly comprised seer fishes (21.12%), pomfrets (7.29%), mackerel (4.19%) and tunas (3.49%). Oil sardine was the major component of the catches of cast nets.

Species composition

A variety of fishes constitute the pelagics of the Mangalore area (Table 2). The important ones in the landings (218237.54 tonnes) of all gears are oil sardine, mackerel, anchovies, carangids, lesser sardines, tunas and seer fishes. These collectively formed 96.43% of the pelagic fish catches 1970 through 1984.

Oil sardine was the most dominant pelagic constituting as much as 62.06% (135440.50 tonnes) of the total landings. Most of the oil sardine catch (97.45%) was landed by purse seine units. The rest was accounted for by shore seines particularly Rampani, gill nets and cast nets.

Mackerel was the next important pelagic comprising 18.61% (40608 tonnes) of the period's catches. The bulk (93.88%) of mackerel was caught by purse seines and the rest by shore seines and gill nets.

Anchovies ranked third among the pelagic caught in the Mangalore area. They account-

ed for 10.09% (22024.70 tonnes) of the total landings. Almost the entire catch (99.79%) of anchovies was brought in by purse seines. *Stolephorus devisi* formed the core of the fishery. This new-found resource was tapped in large quantities by purse seines. That this was possible after the introduction of purse seines shows the importance of the gear.

Carangids formed 2.19% (4771 tonnes) of the catches. Purse seines accounted for almost all the landings (99.33%). Important carangids that contributed largely to the catches were *Caranx kall*, *Chorinemus* spp. *Decapterus* spp. and *Megalaspis cordyla*.

Lesser sardines constituted 1.98% (4318.90 tonnes) of the period's landings. Purse seines brought in all the catches. Only two species, viz., *Sardinella gibbosa* and *S. brachysoma* supported the fishery.

Tunas comprised 1.50% (3275.90 tonnes) of the total landings. The bulk (94.35%) of the catches was accounted for by purse seines and the rest by drift gill nets. The catches were composed of *Euthynnus affinis Auxis thazard*, *A. rochei*, and *Thunnus tonggol*.

The larger pelagics, seer fishes formed 0.56% (1226.37 tonnes) of the catches. Drift gill nets brought in the bulk (98.53%) and purse seines the rest (as incidental catch) of the yield. *Scomberomorus commersoni* followed by *S. guttatus* constituted the core of the fishery.

Some pelagics of lesser importance caught occasionally in bulk by the purse seines were *Thryssa* spp. and other clupeoids. Some fishes brought in excesively by drift gill nets were *Chirocentrus* spp., pomfrets. *Trichiurus* spp., bill fishes and belone.

General consideration

It is seen from the foregoing account that large-scale introduction of purse seines at Mangalore has brought in good returns by way of greatly increased catches of traditional pelagics, oil sardine and mackerel and tapping the hitherto underexploited resources such as anchovies, tuna, cat fishes, carangids, etc., more effectively.

The study, convering the period 1970–84, revealed that 96.30% of the pelagics landed in the Mangalore zone were brought in by purse seines. The resources like anchovies, tunas, carangids, etc., had remained virtually untapped for various reasons, till purse seines moved in. Further, efficient gears like boat seines of the Kerala coast are not to be found along the Karnataka coast to reap the harvest of vast resources like anchovies. Hence, the indigenous gears such as shore seines, gill nets and cast nets could not exploit them. The advent of purse seines in 1976–77 made it possible for the Karnataka fishermen not only to tap the hitherto underexploited resources but also to greatly increase the catches of conventional pelagics, oil sardine and mackerel.

Invariably, the purse seine boats fished in areas close to the 20-metre line which have been the haunts of artisanal fishermen operating traditional gears. This greatly affected the livelihood of the traditional fishermen. For years, Rampani was the most popular gear of the Karnataka coast whose operation maintained the economy of a large segment of the fishing community Till the large-scale introduction of purse seines, the bulk of the catches of mackerel and oil sardine was accounted for by this giant shore seine. Besides, each Rampani required greater man-power for its operation than a purse seine unit. Rampani also

generated employment potential for a larger number of fishermen for transport and preservation of catches. This situation deprived a large segment of the fishing community of their livelihood. Further, the landings of the purse seine units are restricted to the places where berthing facilites for the vessels are available. This restricted the distribution of employment to very limited landing centres thereby denying employment opportunities to a good number of active fishermen and their dependents all along the coast. The artisanal fishermen after initial resentment at the change-over to purse seines adjusted to the new situation because of incentives provided by the Karnataka Government and scheduled banks.

As discussed earlier, the average annual catch of the Mangalore area for the period 1977–84 stood at 26580 tonnes which is 33 times the average catch (800 tonnes) of the period 1970–76. This suggests that purse seines boosted the pelagic catches considerably. But, the cpue declined from 2.71 tonnes during 1977–79 to 1.93 tonnes during 1980–84 indicating that any further increase in effort in future may not result in larger catches.

The pelagic catches touched an all-time high of over 38000 tonnes in 1981 and 1982. However, in 1983, the total yield declined to 16189 tonnes owing to the failure of the oil sardine and mackerel fisheries. Though the mackerel fishery picked up in 1984, the decline in the oil sardine fishery continued. The catch for 1984 stood at 26148 tonnes. This situation arose because of indiscriminate fishing of juveniles and spawners of these fishes in 1982.

The purse seine operators with their close-meshed deep nets virtually scoop the water column from Kaup in the north to Kasaragod in the south for pelagic fishes bringing in juveniles as well as adults without keeping the conservation aspects of the fisheries in mind. This has to be avoided by using large-meshed nets which permit escape of young ones of mackerel and oil sardine and restricting or even desisting from fishing during the spawning season.

It is also prudent that purse seiners do not fish in the traditional fishing grounds of artisanal fishermen during October-March when mackerel and oil sardine shoals move towards the coastal waters (Tandel, 1981). This practice, if followed, ensures concurrent development of both traditional and mechanised fishing sectors without engendering rivalary between them, as is presently the case in all maritime states. It is more expedient to operate the purse seiners beyond the 30–metre line where shoaling fishes are known to occur in fair abundance.

In overall interest of all segments of the fishing industry, the authors opine that purse seiners and other mechanised boats need confine fishing to waters beyond well-defined depths. Legislative measures by themselves may not prove to be the panacea for the present situation without the supporting arm of the enforcement machinery Above all, all the segments of fishing community need be taken into confidence before even attempting to find a solution to their problems.

Among the indigenous gears, the drift gill net is the only gear which has survived the impact of the purse seine. This has flourished recently owing to the fact that good financial returns have accrued to the drift net fishermen because they harvest the larger commercially important pelagic like seer fishes, tunas, bill fishes, pomfrets, cat fishes, sharks etc., along the Karnataka coast. Unlike the competition between Rampani

and purse seine units in exploiting the smaller pelagic fishes, there exists no such situation between drift gill net and purse seine units—the drift gill net is operated at night for larger pelagics. The larger pelagics which are of great economic importance because of their high unit value can be exploited in greater quantities by augmenting the present fleet of mechanised vessels and motorising the existing canoes so as to enable them to reach more distant fishing grounds and return well in time for marketing the rich harvest.

In sum, it may be stated that the present returns from the pelagic fisheries of the Mangalore area can be maintained or even increased in the coming years with the existing level of total effort provided exploitation of the pelagics, both small and large, is restricted to the harvestable size and the redeployment of existing effort to more distant grounds is effected.

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Prospects of Pelagic Fish Resources of the Karwar Area (Uttar Kannada)

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ABSTRACT

Karwar is a very active fishing centre on the west coast and is situated at the northern most boundry limit of Karnataka State. With the introduction of purse seiners in the Karwar waters, the pattern of fishing has remarkably changed causing adverse effects on the age-old traditional fishing, especially driving the once famous shore-seine *rampan* into oblivion. Due to greater mobility of purse seiners, apart from traditional mackerel and oil sardine catches, other pelagic resources like seer fishes, pomfrets, tunas, lesser sardines, anchovies etc., which remained hitherto beyond the reach of indigenous gears have come within their operational ambits resulting in very substantial catches of pelagic fishes. Besides, of late, a large number of dug-out canoes with out-riggers are being fitted with power engines for gill net fishing which hold bright prospects for better catches, of palegic fishes.

Karnataka state with coast line of about 300 km, has made stupendous strides in the development of marine fisheries by introducing purse seiners on commercial basis for the first time in the country in the mid-seventies, and stands foremost among the maritime states. As a result, the marine fish catches of this state registered 63% increase over the average catch of 1.03 lakh tonnes of the past decade.

Karwar, is an active fishing centre of Uttar Kannada district and situated at almost near the northern boundary of Karnataka state. With the commencement of purse seine fishing, apart from traditional pelagic fishes viz., mackerel (*Rastrelliger kanagurta*) and oil sardine (*Sardinella longiceps*), other pelagic resources which remained hithertofore beyond the reach of the famous indigenous gear *rampan* came in their ambit which helped to boost the fish catches. In this account the important pelagic fish resources and their abundance in the Karwar waters from 1981 through 1985 have been highlighted.

Fishery season

In Table 1, the estimated catch of all

Table 1. Total catch of pelagic fishes by purse seines at Karwar [in tonnes]

Month	1981–82	1982–83	1983–84	1984–85	Average
August	—	—	—	20.8	5.2
September	672.2	773.3	320.0	1819.8	896.3
October	799.4	1495.6	1721.0	1555.1	1392.8
November	712.0	944.7	682.2	1407.3	936.6
December	915.5	341.0	222.2	871.3	587.5
January	558.3	400.3	575.0	1077.1	652.7
February	1122.3	310.0	1276.6	563.5	818.0
March	685.4	85.5	434.1	738.4	485.9
April	739.5	138.6	655.2	537.6	517.7
May	955.8	128.0	262.3	151.6	374.4
Total	7,160.4	4,617.0	6,148.6	8,742.5	6,667.1

fishes by purse seiners only is given. During 1981–82, the catch amounted to 7,160 t; however, in the ensuing season the landings recorded decline of 76%. In 1983–84, the cathes were up on the previous year by 2,533 t. During the next season, they surpassed that of 1971–82 and recorded an increase of 58% over the previous year's catch.

In Tables 2 and 3, the average catch of different species and groups of pelagic fishes based on the estimated catches are given. It is discerned that the clupeoids and scombroids, as to be expected, constitute the two major groups and are described below:

Clupeoids

Oil sardine alone formed almost half of the total catch of pelagic fishes in the Karwar waters. Except in 1982–83, the January–May period was more productive. The season 1982–83 was a lean one with 1918 t (Table 3) whereas 1984–85 was the most productive season having 4199 t.

The fishery for lesser sardines was practically non-existent prior to the advent of purse seiners in the Karwar area. However, this new resource comprising *Sardinella fimbriata*, *S. albella*, *S. quibbosa* and *S. davi* is now being profitably exploited. Their catches of 994 t in 1981–82 improved to 1,264 t in 1984–85 and their contribution to the total is 11.6%.

Anchovies (*Stolephorus devisi*, and *S. bateviensis*) is also a new found resource and has been gradually attaining importance and forming 2.7% of the catch. Occasionally *S. buccaneeri* also appear in the landings. They are abundant during the September–December period (Table 2). Their average annual catch for the four year period was 183 t.

Scombroids

Among the Scombroids, the mackerel is by and large the most important fish and during 1981–82 its estimated catch was 965 t but declined perceptibly during the subsequent two seasons. The fishery revived in 1984–85 with a catch of 1,064 t. Mackerel formed just 8.5% of the pelagic fish catches.

Tuna were hardly caught in the Karwar waters save for a few numbers occasionally by gill-netters. However, with operation

Table 2. Monthly average catch [in tonnes] of pelagic fishes at Karwar for 1981–82 to 1984–85

Month	Oil sardine	L. sardine	Anchovies	Mackerel	Tuna	Seer fish	Pomfret	other fishes	average total 1981–85
Aug.	00.4	—	—	4.7	—	—	—	0.2	5.3
Sept.	195.1	151.3	2.5	221.0	60.0	6.1	22.3	238.1	896.4
Oct.	383.5	254.1	21.8	114.6	48.1	1.7	129.4	439.5	1392.7
Nove.	648.0	44.4	74.9	21.9	5.0	0.3	4.2	137.9	936.6
Dec.	361.4	46.4	33.1	2.8	—	0.02	0.1	143.9	587.7
Jan.	523.5	48.9	4.2	1.5	—	—	0.2	74.3	652.6
Feb.	709.4	61.7	5.0	0.8	—	—	0.01	41.1	818.0
March	208.3	15.9	10.1	131.9	2.3	—	2.8	114.6	485.9
April	225.8	49.8	5.9	64.2	23.1	—	0.01	148.9	517.7
May	71.7	103.0	26.0	3.8	1.8	0.1	2.3	165.6	374.3
Total	3327.1	775.5	183.5	567.2	140.3	8.2	161.3	1504.1	6667.2

Table 3. Monthly average catch of various species

Month	Oil sardine 1981–82	1982–83	1983–84	1984–85	Lesser sardine 1981–82	1982–83	1983–84	1984–85
August	—	—	—	1.5	—	—	—	—
September	29.2	317.8	2.4	430.9	33.4	122.5	91.7	357.4
October	187.3	466.6	596.2	283.9	173.1	167.8	18.8	656.6
November	553.2	689.3	375.8	973.5	39.8	38.7	44.3	54.9
December	893.1	122.6	89.6	340.3	14.8	109.3	—	61.4
January	452.3	95.1	478.6	1068.2	101.1	83.7	10.9	—
February	1065.6	118.6	1258.9	394.3	52.2	52.5	16.1	125.9
March	246.1	4.4	372.8	200.0	28.2	33.7	1.8	—
April	.005	58.5	439.8	404.9	141.3	49.9	—	8.0
May	—	35.0	150.5	101.5	410.1	1.9	—	—
Total	3,426	1,917.9	3,764.6	4,199.0	994.0	660.0	183.6	1,264.2

Month	Tuna 1981–82	1982–83	1983–84	1984–85	Seer fish 1981–82	1982–83	1983–84	1984–85
August	—	—	—	—	—	—	—	—
September	5.6	12.0	41.8	180.4	—	20.0	0.5	3.9
October	27.6	149.6	2.0	13.1	—	1.8	1.5	3.6
November	—	—	—	19.9	—	—	1.4	—
December	—	—	—	—	—	—	0.1	—
January	—	—	—	—	—	—	—	—
February	—	—	—	—	—	—	—	—
March	3.1	—	6.0	—	—	—	—	—
April	6.5	—	85.8	—	—	—	—	—
May	6.5	—	—	0.7	—	0.1	0.3	—
Total	49.3	161.6	135.6	214.1	—	21.9	3.8	7.5

and groups of pelagic fishes at Karwar [in tonnes]

Anchovies				Mackerel			
1981–82	1982–83	1983–84	1984–85	1981–82	1982–83	1983–84	1984–85
—	—	—	—	—	—	—	18.6
—	—	10.2	—	580.4	1.5	14.6	287.5
—	40.1	0.7	46.4	161.7	14.1	125.4	157.4
70.7	70.9	130.3	27.6	46.3	19.1	4.3	17.7
—	40.1	91.8	0.2	3.6	5.6	—	1.8
0.1	6.0	10.7	—	—	0.2	3.5	2.1
—	1.0	2.0	18.8	—	—	—	3.3
8.2	2.4	29.7	—	—	—	12.7	514.7
2.3	14.2	7.1	—	167.9	0.6	27.8	60.6
13.4	61.4	12.4	16.9	5.2	3.7	5.7	0.7
94.7	236.1	293.1	109.9	965.1	44.8	194.0	1,064.4

Pomfret				Other fishes			
1981–82	1982–83	1983–84	1984–85	1981–82	1982–83	1983–84	1984–85
—	—	—	—	—	—	—	0.7
—	6.5	5.6	77.3	23.6	293.0	153.3	482.4
—	450.7	28.1	38.9	249.8	204.9	948.3	355.2
—	0.5	15.3	0.9	1.9	126.2	110.8	312.7
—	—	0.2	—	4.0	63.1	40.5	467.6
—	0.3	0.7	—	4.8	215.0	70.7	6.9
—	0.02	—	—	4.4	137.4	1.4	21.2
11.0	0.2	—	—	388.9	34.9	11.0	23.8
—	0.1	—	—	421.5	15.3	94.7	64.0
9.0	0.3	0.04	—	511.6	25.7	93.5	31.9
20.0	458.6	49.9	117.1	1610.5	1115.8	1524.2	1766.4

of the purse seiners this potential resource is being marginally exploited. There are two productive periods for tunas, one during September–November and the other being March–May (Table 2). The important species landed are the little tuna *Euthynnus affinis*, frigate mackerel *Auxis thazard* and *A. rochei* (bullet mackerel). Rarely, the Oriental bonito (*Sard orientalis*), the big eye tuna (*Thynnus obesus*) and skipjack (*Katsuwonus pelamis*) appear in the landings. During 1981–82, they contributed 49.3 t only, but registered a four-fold increase in the catches in 1984–85. Tunas formed about 2.1% of the total fish catches.

Narrow-barred Spanish mackerel *Scomberomorus commerson* and *S. guttatus* are the important seer fishes of the Karwar waters and are appreciably caught during September and October. During 1982–83 their landings totalled about 22 t, but their catches have recorded a downward trend (Table 3) in the subsequent years.

The black pomfret, *Formio nigre* is found in abundance usually during September–November period. Recorded catches of 458 t were made during 1982–83 but in the next season the landings were as low as 50 t. In 1984–85 the catches improved by 67 t over the previous year.

Occasionally, the white pomfret, *Pampus argenteus* appear in the hauls but their contribution is negligible.

Other fishes

Under this group, fishes which do not normally and regularly appear in the purse seiners have been included. The most important groups are Carangids (*Megalospis cordyla*, *Decapterus russelli*) *Engraulids*, *Trichiurids*, *Leiognathids*, at times rainbow sardines (*Dussumieria* spp) and white sardine (*Kowala coval*). Leatherjacks and dolphin fish–*Coryphaena* spp also appear in purse seine catches at times in large numbers. This catagory of fishes contributed as high as 22.5% to the total of all fishes.

General observations

Excluding oil sardines and mackerel resources, the other fish resources described above are new to the Karwar waters, and it has been possible to exploit them to a certain extent due to the introduction of purse seiners. From Karwar fishing centre alone about 50 vessels are operatting and it is envisaged that in the coming years a good number of this gear would be added to the existing fleet. In other words, the pelagic fish catches would also increase. In this context, it may be pointed out that according to Unesco report (1985) the total abundance of mesopelagic fish in the northern and western Arabian sea is of some 62–150 million tonnes. Efforts should be made to harvest at least 5–10% of this existing resource.

Due to the purse seiners, the shore-seine, *rampan* has become obsolete. Because of this, the state Government has taken action to diversify the fishing activities. One is by extending incentives to fishermen to go in for gill-netters. Because of this, of late, a good number of small wooden boats in and around Karwar have been fitted with inboard and outboard engines which have helped the fishermen to cover wider areas. This holds immese prospects for the exploitation of seer fishes, tunas and pomfrets.

It is seen that over the years, the oil sardine fishery has almost stabilised in this region. According to Sekharan (1974) the annual average standing stock is to the tune of 4 lakh tonnes. Therefore, there is still a vast scope to increase the catches from the

present level. Practically, 90–95% of the catch of this fish at Karwar is used as menure after sun-drying. It is felt that this fish could be processed profitably for human consumption which is the dire need of the hour. Even a part of this catch could be converted into fish meal, since the only plant in this district is having very limited capacity.

Furthermore, it has been observed that whenever tuna catches are made, the fishermen are almost compelled to resort to distress sales as there is no local market at all for these. Therefore, it is all the more necessary that entrepreneurs come forward for not only canning tunas but other fishes also which would find ready markets abroad.

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Scope for Improving the Economy in Todays Fishing Operation

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ABSTRACT

The present day fishing vessels are experiencing poor economy due to increased fuel costs which is their major operational cost. Some ways and means of cutting down the fuel costs to the Indian fishing fleet has been suggested for realising immediate benefits in its overall economy. Importance of stock management, selection of alternate methods of fishing, vessel operation and vessel design technology in tackling the vessel economy is discussed.

Introduction

The modern fishing technology was primarily based on the easy availability of petroleum based fuel. In the last decade, due to acute short supply of these fuels, the fuel prices shot up, bringing an awareness among the designers, operators of fishing vessels for adopting fuel conservation methods in various facets in fisheries. Though India has increased its fuel oil production capacity, it has not become self-sufficient in oil. Under the circumstances, it is imperative for us to adopt some radical changes in the way we do things.

The Indian fishing industry, which is almost well-established in the coastal fisheries and is extending its activities in offshore and deeper waters is worried about its cash flow because of the increased operational costs, unsecured fish harvests and unassured markets. Fuel being the major portion of the operating costs, it is worthwhile to make an attempt in adopting some of the ways of energy conservation and overall improvement in fuel efficiency of fishing units. Looking at the energy intensity required for producing food by some of the methods, it is clear that the fishing is one of the most energy intensive means of producing food (Table 1)[1]. This means that with every increase in the cost of energy, the fishing industry becomes less and less competitive and the fish becomes more expensive. Even so, some types of fishing are very energy effective and are discussed later. Any improve ment in the utilisation of energy will have a more pronounced effect upon fish production than other foods.

Table 1. Comparison of energy inputs for various foods

Food sector	Energy output: Energy input	Protein output (gm protein): Energy input (MJ)
Dairy	0.55	5.5
Cattle and sheep	0.59	5.4
Sheep	0.25	2.7
Pigs and poultry	0.32	3.2
Cereals	1.90	15.6
Fisheries	0.05	2.0

The MJ unit (Mega Joule) is equivalent to 328.8 K.cal

Fuel saving potential

Fuel cost alone constitutes about 30 to 50% of the cost in modern fishing. The main objective should be to reduce the fuel consumption per ton fish landed. A large portion of the saving potential can be realised just by changing the present fishery

regulations if any, deploying the fishing fleet and operating pattern of the vessels.

The main areas of fuel benefit realised are:

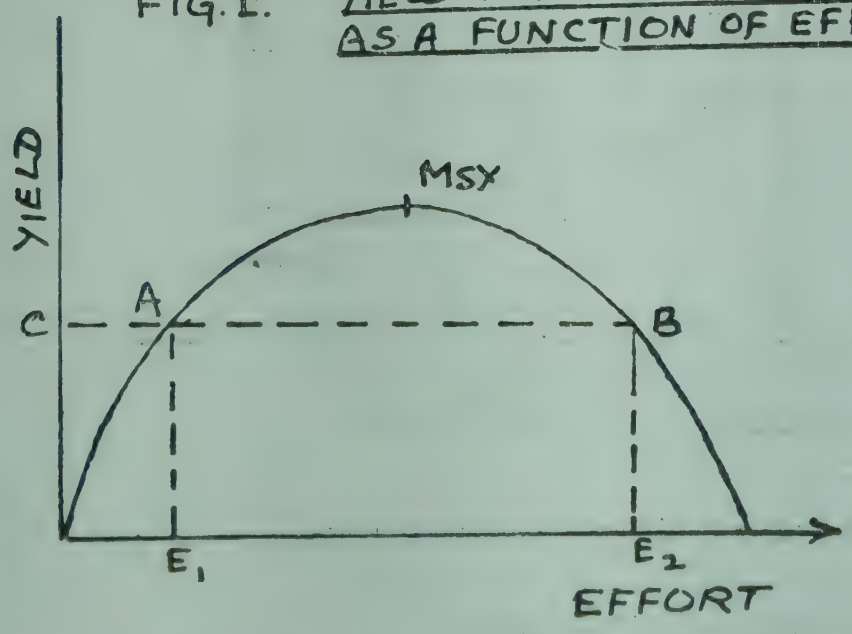
1. Stock management.
2. Selection of fishing methods and gear development.
3. Vessel operation.
4. Vessel design technology.
5. Education and training.

Stock Management

Management of fish stock is very essential to ensure regular harvest of these stocks for vessel operators. Over exploitation of the resources will not only lead to depletion of the stock but also brings poor economy to the vessel operators. Further, it is well-known that less fuel is needed to be spent to harvest a unit quantity of an under exploited fish resource than in an over exploited fish resource.

The relationship between the yield from a known fish stock and the fishing effort can be shown as in Fig. 1.

FIG. 1. YIELD FROM A FISH STOCK AS A FUNCTION OF EFFORT.



Most traditional fish stocks are over exploited today and we are operating at point B of the yield curve. The same catch C could be landed with a smaller effort E_1, and correspondingly with lower fuel consumption, by rebuilding the stock.

In other words, for a given effort, rebuilding the fish stocks shall reduce the energy required to harvest a given quantity of fish, thereby the fuel efficiency in fishing fleets could be attained. Stock management is seen as an interdisciplinary activity that need co-operation between biologists, economists, technologists and legislators. Quota system may be implemented so that the minimum required stock is maintained.

Selection of Fishing Methods and Gear Development

Though fishing is very energy intensive means of food production as seen earlier, there is a great difference in energy intensity in different fishing methods A comparison of energy use in defferent fishing methods (Table 2), shows that static methods use less fuel than trawling and purse seining is probably the most energy efficient methods of all.

Table 2. Comparison of energy use in different fishing methods calculated for some Norwegin Fisheries

Methods of fishing	Fuel ratio Kg fuel/Kg fish
Bottom trawling (middle water)	1.0
Bottom trawling (deep water)	0.6
Longline (fully mechanised)	0.3
Longline (near water)	0.2
Gillnets, lines (coastal fishing)	0.1
Purse seining	0.07

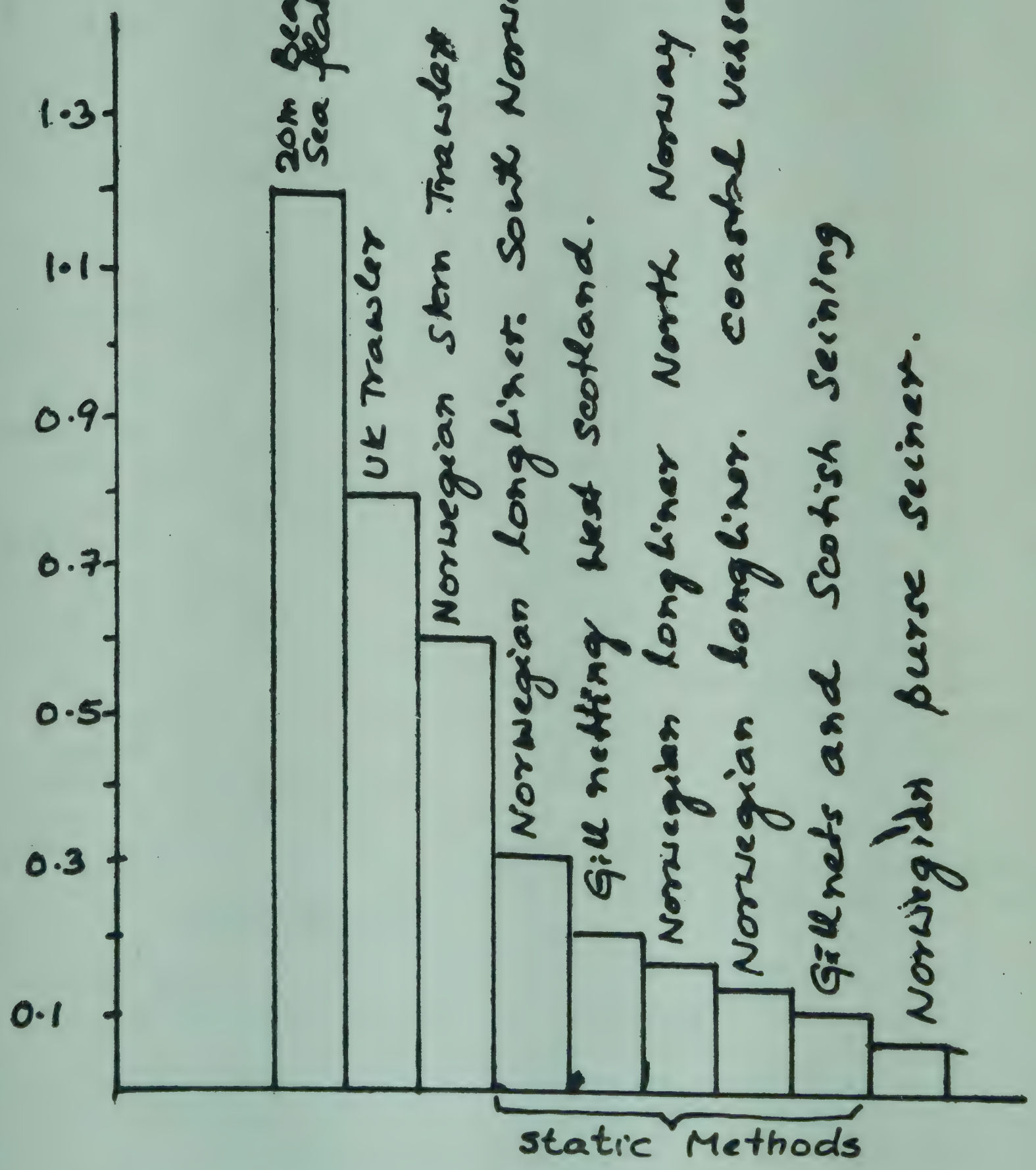
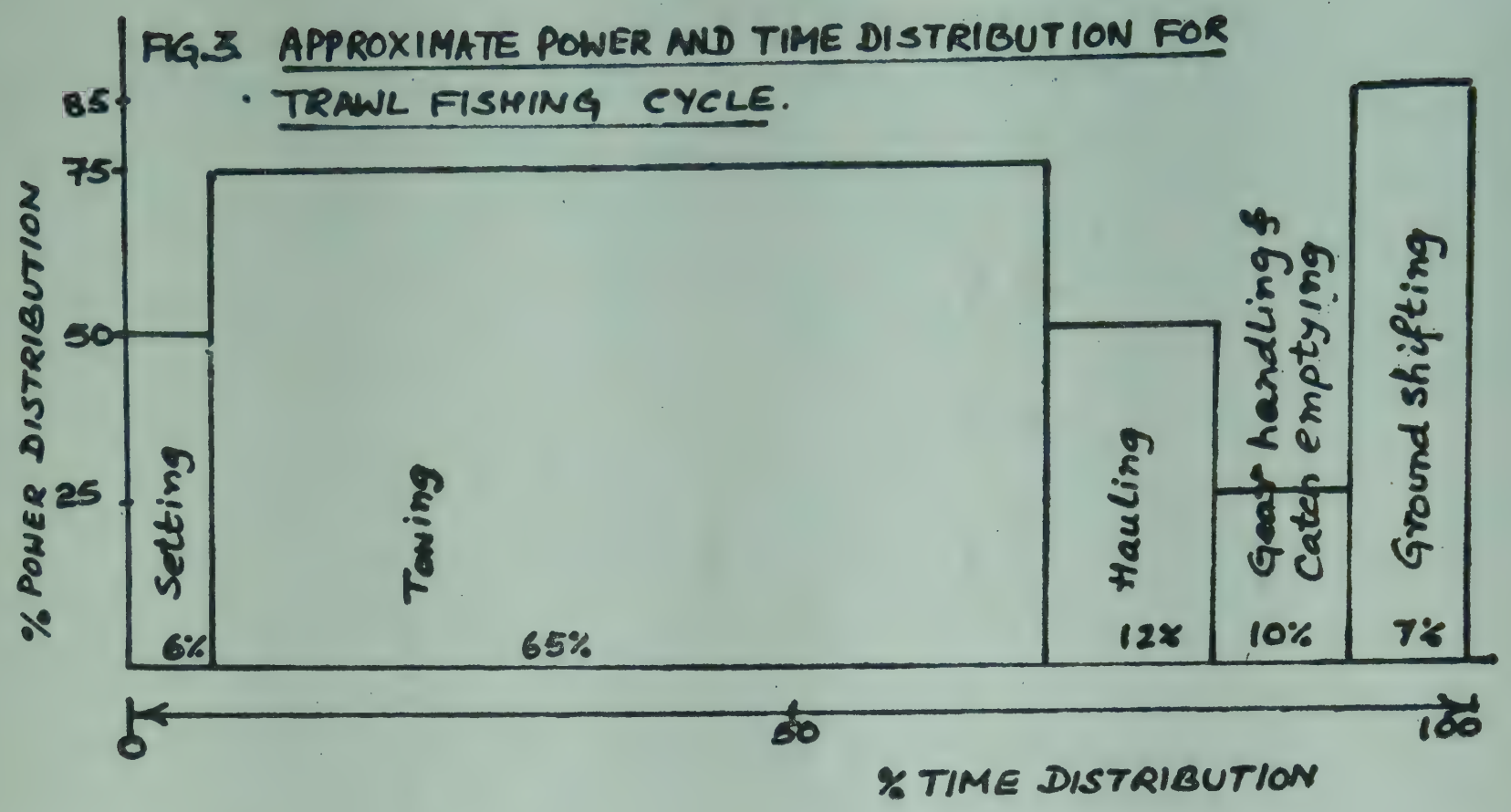


Fig. 2. Histogram showing fuel consumption rof different fishing methods.

Source: Norwegian Institute of Fishery Technology Research.



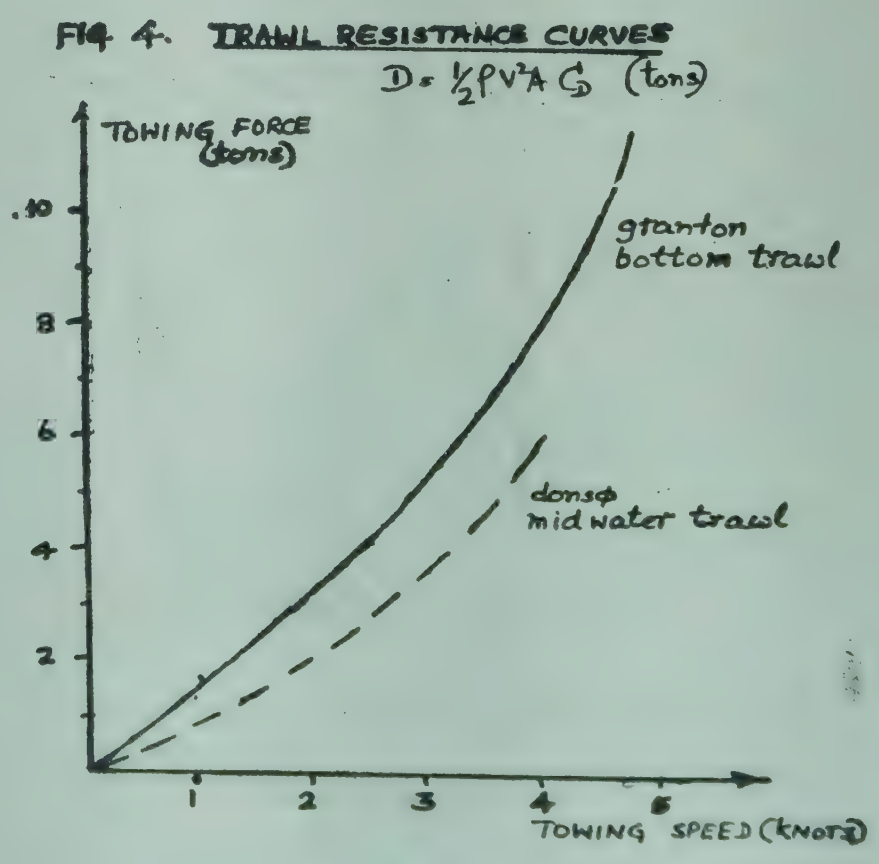
It can be seen (Table 2) that trawling is far more vulnerable to fuel price increase than gillnetting and longlining[2]. Hence, static methods are very attractive, fuelwise and may be more suitable in an uncertain future. Fuel ratios for some specific methods of fishing are shown in the histogram (Fig. 2).

Though, great seasonal variations, productivity and profitability in each method are not reflected in the histogram, it highlights the possibilities for fuel saving efforts by static methods. Most of the research on fishing gear has been directed towards improving trawl gear technology and the trawler, and little effort has been made on developing the static gears and the vessel used for their operation. However, the pressing need for fuel efficiency has lead to increased research and interest in static methods in recent years.

Low drag trawls

In case of trawling it can be seen that 65% of the time, the vessel is engaged in towing the gear at about 75% of the main engine power (Fig. 3) and the fuel consumed in this phase is enormous. Any saving potential in this era will improve operational economy of the vessel.

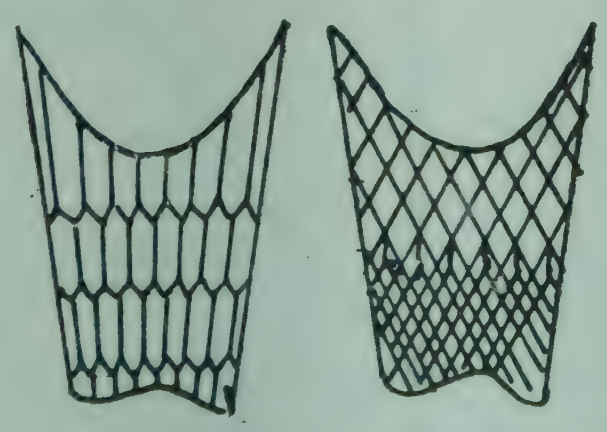
Further, exact matching between the gear, the vessel and the main engine is required in case of trawler to get the best use of the power available and this is very complicated. The power required to tow a trawl at different towing speeds is shown in Fig. 4.



As the speed is increased the towing power required is increasing to some power requiring more fuel. Hence, one of the simple way of attaining fuel conservation is by developing low drag trawls. Intensive research in recent years[3] has lead to the use of ropes and big meshes of over 10 metres in pelagic trawls (Fig. 5).

Reduction in the projected netting area will result in lowering the drag. The mesh size can be increased in the front part of the trawl to quite a surprising extent without affecting the catching performance. The rope trawl is now being superseded by the hexagonal mesh or large diamond mesh trawls since the distribution of stress in the netting is much improved. Net drag reductions of 30% and fuel consumption reductions of 20% during trawling have been reported[3]

1. Conventional pelagic trawl
2. Pelagic rope trawl

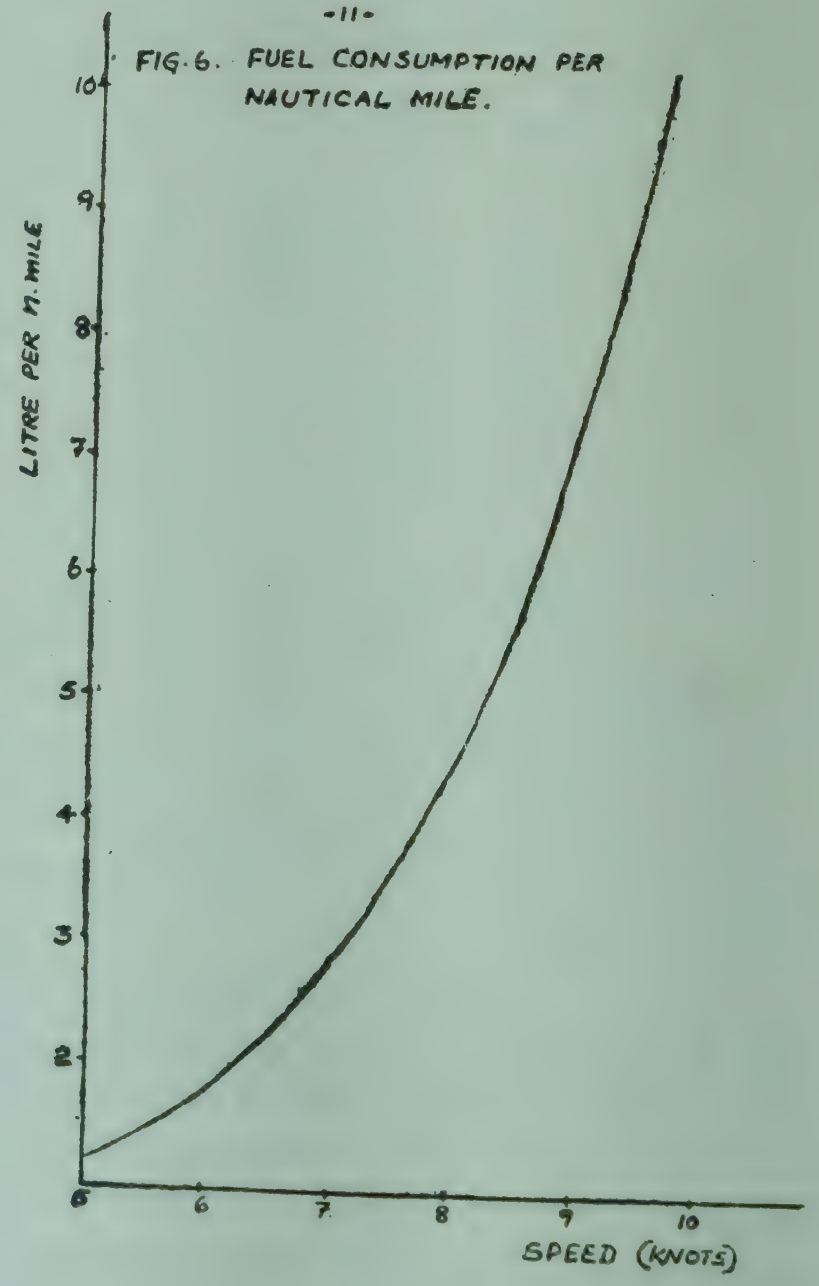


3. Rope Hexagonal mesh pelagic trawl
4. Large mesh pelagic trawl

Fig. 5 Comparison of low drag pelagic trawls

Vessel operation

With the increase in the fuel costs which is the major expenditure in vessel operation, the skippers, fishermen and owners have begun to realise the cost efficiency in fishing. It is not the landed volume that counts but the profit resulting from catching the fish. Developing an information system in fisheries on a national level is very important, which could feed skippers all the required informations on resources, catch rates, weather, ground, etc. and thus reduce time and fuel spent for steaming and searching fish. It is usual that 40 to 50% of fishing fleets' fuel consumption is spent on free running. Hence, there is necessity to examine the choice of free running speed carefully. Presently, it is common to go to the fishing ground in full speed consuming large quantities of fuel. Steaming at higher speed than essential leads to fuel penalty (Fig. 6).



This explains why speed reduction is the most effective measure for reducing the fuel consumption and it is the casiest way available to the skipper without any investment. A 7% speed reduction reduces the fuel consumption by 50%.

Economical speed selection

To select the proper speed for a given situation, the use of time must be balanced against the use of fuel. This concept has been reported to the first time by Degernes[5]. A reduction for speed increases steaming time. If one considers increasing speed, the questions to be answered are:

—What is the alternative use of the steaming time saved?

—Is the value of the time saved equal to or higher than the extra fuel cost?

For a given vessel, the only costs influenced by a change of speed are:

(i) time cost (i.e. a value allotted to time). In a free fishing situation like in India, this extra time could be used for fishing and then the time value is the net income that can be expected from fishing.

(ii) Fuel cost:—the cost required to steam at the speed. This can be represented in the following diagram (Fig. 7).

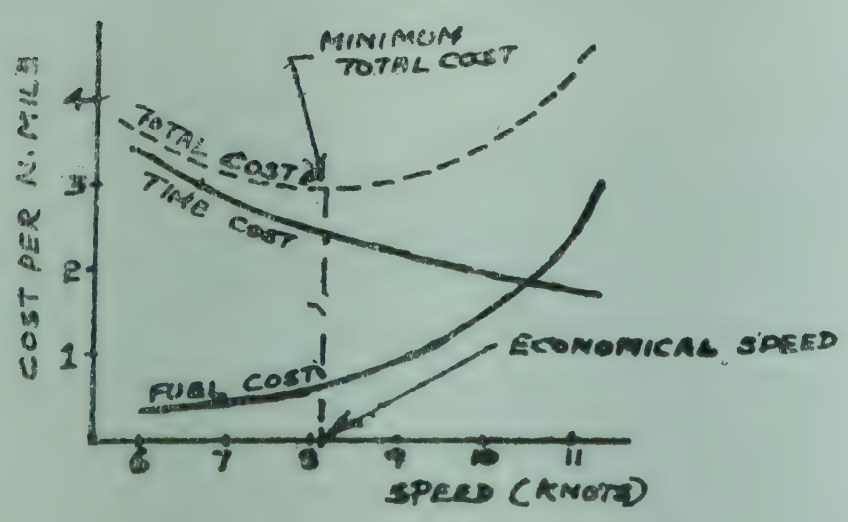


Fig. 7. Minimum cost curve

The time cost per n. mile is reduced by increased speed, while the fuel cost per mile is increased. Adding the two curves gives us a total cost curve representing the distance cost. This curve has a minimum point at the economical speed. The location of the minimum point depends on fuel prices and rates, which may vary throughout the fishing season. This means that the proper speed should be considered every time a distance is steamed keeping in mind the alternative use of the time and the value of this use.

The speed selection is basically a question of balancing fuel consumption against time consumption. In effect, we are buying time with fuel and hence care should be taken not to pay more for the time than it is worth.

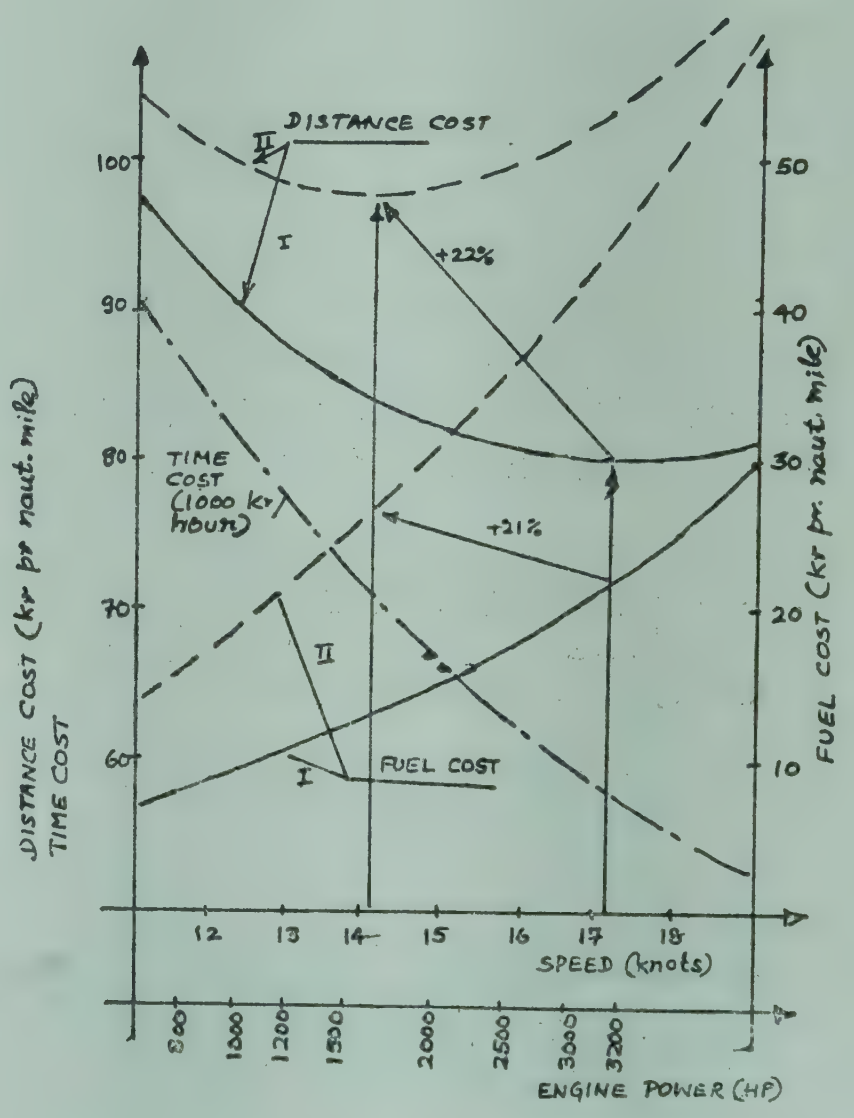


Fig. 8. Example of change in distance cost with fuel price increase

ALT I : KR 0,64 pr litre fuel
ALT II : KR 1,32 pr litre fuel } + 106%
Vessel Length : 230 feet

The economical speed selections for a 235 footer Norwegian vessel at two different fuel levels are shown in Fig. 8. It can be seen that doubling of the fuel price reduces the economical speed from 17.3 to 14.2 knots with a corresponding power reduction of 50% with no change in time value. Hence it is vital to make such consideration in today's fisheries in India.

Vessel Design Technology

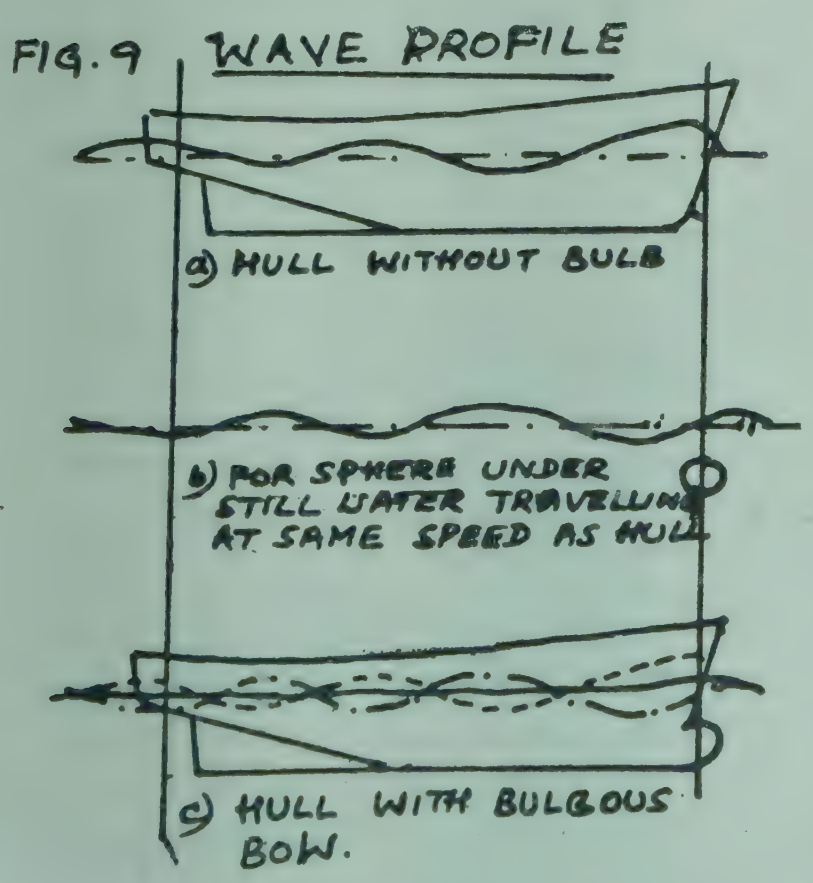
This includes a large number of disciplines such as designs of hull, repulsion system, machinery, etc. There should be a good balance between them in order to get the best out of the total vessel.

Hull and appendages

The requirement for space, volume and stability combined with regulatory restrictions on length has resulted in the development of modern fishing vessel. The length of the vessel influence the speed of the vessel (in the form of speed length ratio) and thus the fuel consumption. Restrictions on the length certainly increases fuel consumption. Stubby vessels may have reasonable resistance in still water, but its rough weather performance is usually poor with high speed loss and fuel consumption. There are several ways by which the total hull resistance could be reduced. The use of bulbous bow is very common in the developed countries. Fig 9 is the simplified diagramatic explanation of the priciple of the bulbous bow, which is one of wave interference.

A wave generator such as a sphere or a bulb could be positioned relative to the hull in such a way that the wave system from the wave generator cancels out the wave system from the vessel, thus reducing the wave making resistance. For fishing vessels, improvements of 5 to 15% have been reported. A new type of bulbous bow has been developed by the Institute of Fishery Technology Research, Norway (FTFI) (Fig. 10) for the stubby vessels.

The model test results of vessel of high beam-length ratio, before and after fitted with this new type has showed execptional performance with reduction of resistance



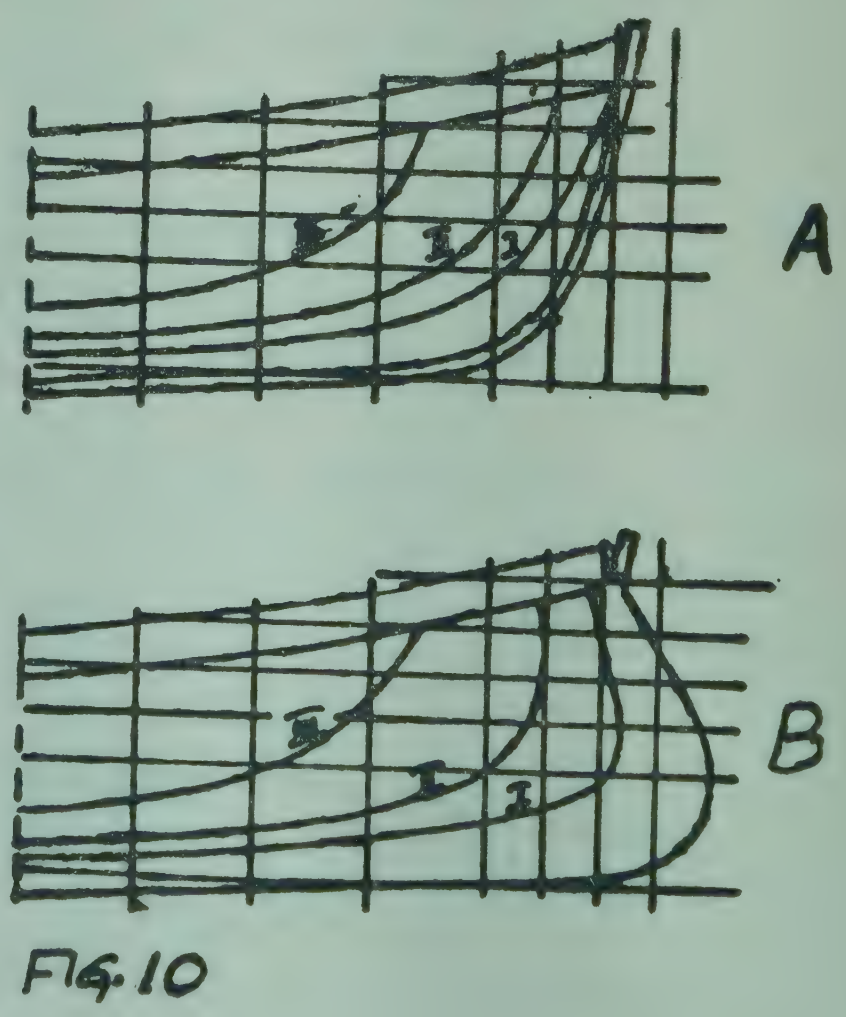


FIG.10

by 25 to 30%. Hence, it is interesting to use such type of bulbs to the fishing vessels which are generally of high beam-length ratio.

Further, the use of faired rudder, stern posts and the clean underwater hull will reduce the total hull resistance of the vessel.

Selection of power

Design and selection of the propulsion system is the most important process from a fuel saving point of view. As seen in speed selection earlier, the economical power was reduced by 50% when the fuel price was doubled. Hence, with the uncertain future of oil supply and oil prices, it would be worthwhile to change our ways when selecting the engine size for the vessel if free running determines the power requirements.

Propeller selection

Propeller efficiency depends largley on the proper choice of propeller rpm and diametre. The casiest way to increase propulsive efficiency is to reduce the design rpm of the propeller with corresponding increase in diametre. As a rule of thumb, reduction of propeller speed to half and increase of its diametre to one third will reduce the required power to one fourth. The disadvantage of greater cost for such larger propeller, shaft, bearing, etc. is weighed against reduced size and cost of engine and the fuel savings over the life of the vessel.

Propeller nozzles

Nozzles around a propeller may be an attractive device for trawlers where the vessel's towing thrust is increaed. The additional thrust from the nozzle is due to the water speeding through it (Fig. 11).

When trawling, a nozzle may give 20 to 25% additional thrust, with the possibility for a corresponding saving in fuel. It should

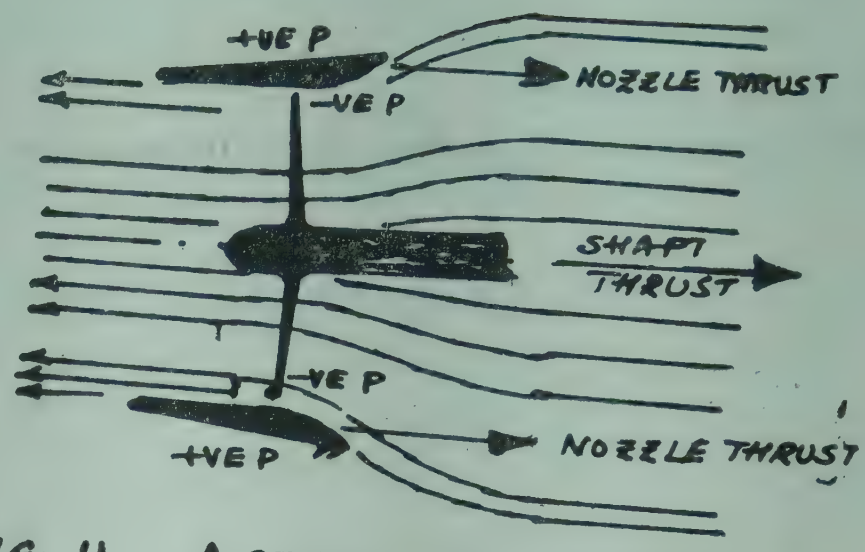


FIG. 11. ACTION OF NOZZLE

be remembered that a nozzle may have detrimental effect when free running and it is, therefore, necessary to examine the operating profile of the vessel.

Education and Training

It is important that an awareness to cut down the vessel operating cost, should be brought into the minds of present day skippers, fishermen and other operators. They must be educated and trained in various aspects of instrumentation used in measuring the vessel performance. Fuel gauges located in the wheel house have a great value in educating skippers on the importance of speed selection. In future fishing this instrument will be as importanant as the compass today.

Conclusion

To improve the economy in today's fishing in Karnataka, it is highly essential to improve the fuel efficiency and to adopt the fuel conservation methods in fisheries in general. Some of the simple and easy approches to attain these have been recommended:

1. It is of great importance to have resource management for the regular harvest of fish resources in future and also to reduce the fuel energy required to harvest unit quantity of fish. Reducing the fishing effort and/or imposing quota system to

the vessel operators are recommended to sustain the resources that show signs of over-exploitation, especially the shrimp, sardine and mackerel.

2. Use of energy efficient methods of fishing may be adopted to harvest the presently under-exploited resources of tuna in the deeper waters off Karnataka.

3. Low drag gears can be used to improve the gear efficiency and their catching efficiency. Use of rope trawls, hexagonal mesh trawls are recommended for trawls especially the trawls used for catching fishes.

4. As the vessels' major portion of the fuel is spent in free running, it is imperative to reduce the consumption at this phase of the trip cycle. Steaming at higher speed than essential leads to fuel penalty. Hence right choice of economical speed for steaming is suggested based on the value of time and the fuel cost for a particular fishing situation.

5. Development of low drag hulls for new vessels and existing vessels are recommended. Bulbous bow for stubby type vessels is recommended, which will reduce the hull resistance by 25 to 30%.

6. Selection of power, propulsion system for best use of them is suggested. Installation of large propeller with corresponding reduction in speed is recommended for fuel benefits. Propeller nozzles recommended to increase the thrust for the vessels whose major part of operating cycle is towing.

7. An awareness to cut down the vessel operating cost should be brought into the minds of skippers, fishermen and other operators to get total fuel efficiency in today's fishing. Installation of fuel guages in the wheel house to monitor fuel consumption is recommended for attaining this.

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Craft and Gear needs of Karnataka's Marine Fisheries during the next decade

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ABSTRACT

While mackeral and sardine, the two most important pelagic fishery resources contributing nearly 50–60% of the Karnataka's marine fish production are facing depletion due to overfishing by purse seining, Anchoviella, cat fish leognathus, and tunney are showing bright prospects for future purse seining. Penaeid prawns in Karnataka also show symptoms of depletion in line with the national trend due to overfishing. Out of the forty odd marine species listed, 10 species including the above seven species and sharks, seer and cephalopods constitute between 70 and 80% of the marine fish production of the state.

A mixed strategy of discipline, control, regulation and even moratorium coupled with controlled and orderly purse seining for the development of species other than mackerel and sardine, group long lining for shark, selective gill netting for seer and shark, trolling line for seer and jigging and dip-netting for cephalopods are suggested. Another suggestion is the feasibility study by the state for the exploitation of tuna, oceanic squids, measopelagic and demersal species of distant waters including the EEZ.

Craft and Gear for the judicial exploitation of the above 10 species based on the maximum sustainable yield are recommended.

Introduction

Karnataka with its coastal line of nearly 300 kms. forms one of the most important resourceful area of the pelagic belt of south west coast of India contributing about 8–10% in the national marine fish production. A perusal of the fishing performance of the state for the last ten years indicates at a glance a gradual and well orderly growth and development keeping in pace with the national growth in the fish production. However, a critical analysis of the present trend reveals that it is only a superficial one with far reaching deleterious effects on the standing stock of two main species of pelagic resources viz. Mackerel and Sardine which contribute nearly 50–60% of the marine fish production of the state.

The marine fish production of 92,676 tonnes in 1972 (9.46% of the national production) has increased to 127,968 tonnes (9.04% of the national production) during 1982–83, showing an overall increase of 27.5% during the period. Even though there are more than 40 species listed, 70–80% of the States' marine fish production comes from 10 species (Table 1). The production of mackerel and sardine upto 1976 when they were exploitede xclusively by the traditional sector, was between 22 and 35 thousand tonnes and 16 and 21 thousand tonnes respectively. Introduction of purse seining from 1977 on commercial scale has increased the production of mackerel to nearly 51 thousand tonnes in 1978 and thereafter showed a declining trend and reached the lowest ever level of 5.3 thousand tonnes during 1982–83. In the case of sardine the increase was more pronounced and reached a little ever 78.5 thousand tonnes during 1981 and then declined to nearly half during the next year.

Panicker (1982) has estimated the maximum sustainable yield of 33,125 and

Table 1. Landing of ten important species of marine fishes of Karnataka from 1972–1982 [in thousand tonnes]

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	Expected at 1995
1. Anchoviella	0.124	0.235	0.051	0.010	0.054	0.174	0.443	1.721	5.621	7.430	11.088	16.00
2. Cat fish	3.184	2.372	2.011	3.222	4.279	5.162	2.831	9.920	5.354	8.398	10.223	15.00
3. Cephalopods	0.026	0.019	0.020	0.175	3.067	0.965	1.346	0.668	0.122	0.031	0.945	5.00
4. Elasmobranchs	4.587	1.690	2.007	1.725	1.489	3.238	2.051	2.531	2.910	3.591	4.836	10.00
5. Leognathus	0.795	2.689	2.058	1.240	4.086	1.631	4.241	1.565	4.671	1.329	4.015	10.00
6. Mackerel	32.249	35.468	9.696	12.469	22.455	26.214	50.704	40.084	19.634	15.359	5.304	33.00
7. Penaeidpraws	8.058	8.325	12.695	3.074	2.594	3.335	8.422	4.654	3.098	5.313	7.732	8.00
8. Sardine	17.720	16.650	21.000	53.470	15.900	31.320	49.270	37.830	46.850	78.610	38.380	4.400
9. Seer	2.498	1.313	1.532	0.776	1.341	1.831	4.463	1.645	1.941	3.188	1.570	5.00
10. Tunny	0.134	0.124	0.394	0.212	0.576	0.622	0.614	0.171	0.952	2.325	2.236	5.00
Total	69.425	68.885	51.464	76.374	55.841	74.492	124.385	100.789	91.153	124.525	86.329	151.00
of Karnataka's marine fish landings	74.91	75.29	77.97	87.29	58.60	76.67	81.39	80.38	79.04	76.41	67.46	

Expected total marine fish landings of Karnataka by 1995: 188–215 thousand tonnes.

Table 2. Details of landings and Maximum sustainable yield of different pelagic fishery resources of Karnataka

in 000 tonnes

	1977	1978	1979	1980	1981	1982	M S Y
1. Anchoviella	0.174	0.443	1.721	5.621	7.340	10.088	16.00
2. Cat fish	5.162	2.831	9.920	5.354	8.398	10.223	15.00
3. Leognathus	1.631	4.241	1.565	4.671	1.329	4.015	10.00
4. Mackerel	26.214	50.704	40.084	19.634	14.359	5.304	33.00
5. Sardine	31.320	49.270	37.830	46.850	78.610	38.380	44.00
6. Tunny	0.622	0.614	0.171	0.952	2.725	2.226	5.00
Total	65.123	108.103	91.291	83.082	112.361	70.246	123.00

44,250 tonnes respectively for mackerel and sardine along the Karnataka coast and cautioned the possible depletion of mackerel and sardine due to over exploitation. Side by side, introduction of purse seining has also brightened the future of Anchoviella, cat fish, leognathus and tunney fishery (Table 2). Out of the remaining four species, except penaeid prawns which has already shown symptoms of depletion on a national scale, the other three species could be developed for augmenting the marine fish production.

The above trend indicates the necessity of a mixed strategy of discipline, control, regulation or even a moratorium in the exploitation of mackerel, sardine and penaeid prawns, coupled with purse seining on a controlled and orderly manner for the development of Anchoviella, cat fish, leognathus and tunney fishery on one hand, intensification of shark long lining with efficient Gear and group transportation of traditional fishermen and craft by mechanised boats to far off ground and back, introduction of Jigging and dipnetting for Cephalopods and trolling and selective gillnetting for seer on the other hand which can go a long way in developing and stabilising the marine fishery of the state. With the above strategy, it is expected to increase the marine fish production of the state to 188–215 thousand tonnes by the turn of the century.

Exploitation of pelagic fishery resources by purse seining

The purse seine being the most expensive and efficient gear, could as well be detrimental to the fishery itself unless it is regulated and restricted. Panicker (1982) has (MSY) estimated the maximum sustainable yield of mackerel and sardine at 33 and 44 thousand tonnes respectively for the Karnataka area and mixed species including Anchoviella at 78 thousand tonnes. In the present review three more species are added and M. S. Y. for mixed species and for individual fishery worked out (Table 2). Out of the 123 thousand tonnes of exploitable pelagic fishery resources 90–100 thousand tonnes could be exploited by purse seining and the balance by the artisanal sector.

Considering the economics of purse seining, it is suggested that fishing effort has to be fixed so as to maintain c.p.u.e. of 2.6 tonnes for the mixed species, which works out to be between 43000 and 48000 boat days or 285–319 vessels operating 150 days per year. Since deploying of vessels ex-

clusively for mackerel, sardine and the other species is practically impossible, there should be some sort of a regulation or quota system to avoid over exploitation of one species or other.

The present purse seine of Karnataka of size ranging between 500 and 600 m. length and 45 and 50 m depth with 14–18 mm. Nylon knotless webbing in combination with 43 ft. (13.25 m.) purse seiner and 30–32 ft. (9.23–9.85 m.) carrier vessel is the most suitable for the area.

Shrimp trawling

It is a matter of grave concern to all that the shrimp resources are getting depleted due to over exploitation on a national level. Unless drastic measures like mesh regulation, fixing of optimum fishing effort and ban on export of young and juvenile shrimp are adopted our rich shrimp resources will be completely depleted in the near future. Panicker *et al* (1965) has recommended 35.3 mm. cod end mesh for shrimp trawl to conserve the species by fixing 50% escape level at 80–85 mm. length group. However, in the present condition it is suggested that the minimum cod end mesh size may be fixed at 30 mm. keeping 50% escape level at 50–55 mm. length group. It is also suggested that a ban may be imposed on export of grade below 71/90 headless shell on and 130–200 P U D without which it will not be possible to have any effective mesh regulation.

The shrimp potential of Karnataka area is estimated at about 8000 tonnes M. S. Y. and this could be attained only by enforceing the above regulation and fixing the fishing effort at 1,00,000 boat days or 500 trawlers operating an average of 200 days per year. The most suitable vessels are 32 ft. (9.85 m.). and 36 ft. (11.07 m.) fitted with 45–60 and 60–80 H.P. engines respectively.

Exploitation of Cephelopod fishery

Cephelopods are the most under developed and unexploited fishery resources of importance. The national production of cephelopods at present is only little over 17 thousand tonnes. It was only after 1970 the fishery has started picking up mainly due to the demands in the foreign markets. Even now, cephelopods form a by–catch of traditional gill nets, seine nets etc. and of shrimp trawling.

Considering its importance and resource potentialities, cephelopod fishery has to be developed and exploited on a national scale by introducing jigging and dipnetting from medium class vessels using light attraction. This method has to be taken up on a limited scale on a survey cum exploratory nature all along the important maritime states along the east and west coasts.

At present Karnataka's contribution is little over one thousand tonnes and could be developed to a modest estimate of 5000 tonnes by mechanised squid jigging and dipnet operation from 43 ft. (13.25 m) vessel using light attraction technique. In the initial stage 12 vessels may be rigged for squid jigging and dipnet operation; four each from Mangalore, Malpe and Karwar to to study the feasibility of introducing squid jigging and dipnetting. Once the feasibility of the technique is established, an additional 3000 tonnes can be produced by deploying 70–80 vessels equipped with 10 KW. Generator for illumination and operation of 4–6 automatic jigging machine and one dipnet from each vessel.

Seer and Shark fishery

Seer and shark fishery are being neglected by the traditional fishermen of Karnataka with advent of purse seining and of late have assumed importance by the migrant

fishermen of Kanyakumari and Vizhinjam who have made in roads to Dakshina Karnataka. They usually hire dug-out canoes and drift nets from local fishermen besides their own mechanised vessels. Presently seer and shark fishery are exploited exclusively by using drift gill nets except a few cases of shark long line operated by traditional fisherman of Uilal and Kerala.

The annual production of seer and shark comes to nearly 1.5 and 5 thousand tonnes respectively. A systematic approach on the exploitation using selective drift gill netting and trolling for seer and drift gill netting and long lining for shark can increase the production of seer and shark respectively to 5 and 10 thousand tonnes. 25–30 ft. (7.9 to 8.25 m) vessels with 25–30 H.P. Engines are the ideal craft for gill netting. Drift gill nets of 65–140 mm mesh size and 210/6/3 to 210/12/3 Nylon of length 750–1000 m. and depth 10–12 m. can be operated from the above vessels as seer cum shark gill net with 3--4 crew members. A total fishing effort of 25 thousand boat days can bring nearly 3 thousand tonnes of seer and 5 thousand tonnes of shark annually. 30 to 32 ft. (9.25–9.85 m.) vessel fitted with 45–60 H.P. engine can be best deployed for troll line operation for seer. It is estimated that fishing effort of about 11500 boat days with 6–8 troll lines and a crew of 3–4 could catch about 2000 tonnes of seer annually. About 5000 tonnes of sharks could be exploited from deeper waters beyond the operational range of drift gill nets. This could be done by group long line operation from dug-out canoes engaging mechanised boat of 30–32 ft. (9.25–9.85 m.) LOA for transporting the canoes to the far off ground and back, supply of provision, bait etc. A group of six canoes with 500–600 hooks and 3–4 crew members each and with one mechanised boat with 2–3 crew members will form a viable unit. A total fishing effort 2500 unit trips landing an average of 2 tonnes of shark per unit per trip could produce 5000 tonnes of bigger size sharks annuaaly.

Conclusion

Let there not be too much optimism regarding our inshore fishery resources and continued exploitation without any restriction. It is well known, but generally an unnoticed fact that any fishery develops only on exploitation. Exploitation on a limited scale acts as nature's nurturei nducing a slight shift in the ecosystem to a more adoptable condition with a boom in the nutrient as in the case of a natural upwelling enhancing the growth and fecundity coupled with a drastic reduction in the natural mortalility rate. Of course exploitation will add yet another factor into the population, the fishing mortality. This fishing mortality is the catch and is directly proportional to the exploitation level or the fishing effort and this trend will continue in the same manner till a stage is reached when there will not be any proportionate increase in catch with the increase in the fishing effort. A stage below this point is the optimum fishing effort and corresponding catch, the M.S.Y.

In some of the fisheries, there is over fishing and symptoms of depletion are noticed. To avoid such a situation it is high time that a judicial exploitation on a systematic, orderly and controlled manner may be adopted. With this in view, ten important fishery resources of Karnataka contributing between 70 and 80% of the marine fish production of the state are dealt in detail and optimum craft and gear required are summerised in Table 3 & 4.

Any additional input in the development of fisheries could be contemplated in the line of exploitation of tuna, oceanic squids, measopelagic and demersal fishes of distant

Table 3. Details of Craft and gear requirement for 10 important species of marine fishes of Karnataka

Name of fish/fishery	M S Y (t)	By Purse seine (t)	Fishing effort boat days	c.p.u.e.(t) · boat days/year	Type of vessel	No. of vessels	No. of crew	Gear details
Pelagic fishery:—								
1. Anchoviella	16000	12000–13000	3400–3450	3.5	43 (13.25m) purse	22–23	15–18 in purse	500–600 m x
2. Cat fish	15000	11000–12000	3650–4000	3.0	seiner with	24–26	seiner 3–4 in	45–50m purse
3. Leognathus	10000	7000– 8000	1750–2000	4.0	100–120HP &	11–13	carrier vessel	seine of 14-18mm
4. Mackerel	33000	25000–28000	16600–18600	1.5	30-32 (9.23-9.85 m)	110–125		nylon knotless
5. Sardine	44000	32000–35000	16000–17500	2.00	carrier vessel with	105–115		webbing
6. Tunny	5000	3000–4000	2000–2500	1.5	40–60HP engine combind for 150 days/year	13–17		
Total	1,28000	90000–100000	43400–48150	2.583		285–319		
7. Shrimp trawling:—								
Prawns	8000	—	100000	0.08	32 to 36 trawler	500	5–6	25–32 m shrimp trawl
Other fishes	30000	—	—	0.30	with 60–100HP engine 200 days/year		—	—
8. Cephalapods	5000	3000	13000	0.25–0.285	As purse seiner with 10KW generator 150 days/year	70–80	6–8	4–6 automatic jigging machine with 8–12 line and one dip net
9. Seer	5000	—	—	—	—	—	—	—
10. Shark	10000							
Gill net	a. Seer 3000 b. Shark 5000		25000	0.320	25 to 30 (7.69–9.23 m) gill netter with 30–40HP engine 200 days/year	120–130	3–4	210/6/3 to 210/12/3 nylon 65–140 mm mesh 750–1000× 10–12 m gill net
Troll line	Seer	2000	11500	0.175	30–32 (9.23–9.85m) vessel with 45–60HP engine 150 days/year	75–80	3–4	6–8 lines with artificial lure
Long line	Shark	5000	2500 units	2.00/unit	6 dug out canoes & one 30–32 ft. (9.23–9.85m) vessel with 40–60HP engine 150 days/year	16–17 &	2–3	long line with 500–600 hooks

Table 4. Details of vessel requirement for the exploitation of 10 important marine species of Karnataka

Species name	25 ft (7.96m)	30 ft. (9.23m)	32 ft. (9.85m)	36 ft. (11.10m)	43 ft. (13.25m)	Canoes	Fishing effort–boat days
1. Anchoviella	—	22–23		—	22–23	–	3400–3450
2. Cat fish	—	24–26		—	24–26	–	3650–4000
3. Leognathus	—	11–13		—	11–13	–	1750–2000
4. Mackerel	—	110–125		—	110–125	–	16600–18600
5. Sardine	—	105–115		—	105–115	–	16000–17500
6. Tunny	—	13–17		—	13–17	–	200–2600
7. Prawns	—	—		500	–	–	100000
8. Cephalopods	—	—		—	70–80	–	12000
9. Seer & shark	→120–130	—		—	–	–	25000
Seer troll line	—	75–80		—	–	–	11500
Shark long line	—	16–17		—	–	95–100	2500 units
	→120–130	376–416		500	355–399	95–100	194400–199150

waters including the EEZ. State Government could undertake this project as a feasibility study programme by acquiring or chartering two vessels each of 35–40 m. LOA fitted with 750–1000 HP and equipped for tuna long lining, squid jigging and dipnetting and for pelagic and demersal trawling.

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Recommendations that Emerged in the I Session: Marine Fishing

1. There are at present 393 purse seiners and 2,057 trawlers operating in the inshore waters of Karnataka. This effort is considered already an excess. Therefore, surplus fleet of purse seiners and trawlers should be deployed for exploitation of the resources beyond the presently exploited areas. This would not only reduce conflicts of interest between the traditional and mechanised sectors but also would enable increased production.

2. The Anchovy resources off the Karnataka coast offer further increase in effort through purse seines and midwater trawls in the depth zone between 30 and 50 m.

3. Since drift net fishery has survived competition from purse seiners, motorisation of country crafts may be encouraged to fish in and around traditional fishing grounds and also beyond. This will help exploitation of large and quality pelagic species, *viz.* seer fish, pomfrets, carangids, tunas, sharks, etc. in regions where their availability is established.

4. The problem of indiscrimiante destruction of spawners and young fish should be overcome by further studying various aspects of mesh size regulation, regulation of fishing season, etc. In the mean while regulation of the number of purse seines would help to decrease pressure on the presently exploited resources.

5. There is need for further development of infrastructure facilities to meet the demand for handling increased landings, so that good price is realised for the produce.

6. Marketing problems should be tackled in regard to the present produce as well as the additional catches excepted from deeper waters when diversification of fishing takes place.

7. Education of the fishermen and all others concerned with the exploitation of resources on the importance of conservation and management of fishery resources is necessary. Hence, the extension services in the State have to be suitably geared to achieve this end.

8. Efforts are needed for proper utilization of fish during glut conditions.

9. Technology has to be developed for proper utilization of unconventional resources. In this regard development of new products making use of low quality fishes is called for.

10. Since large resources of tuna have been identified off the south-west coast, proper strategy for their exploitation should be evolved.

11. The Central Institutes like CMFRI, CFTRI, FSI, CIFT and CIFNET should provide the necessary information and guidance to the State Government for proper development of the marine fisheries sector.

12. The information available on fuel conservation and efficiency through speed control and improvement in vessel design could be tested under Indian conditions and adopted by the fishing industry, if necessary with certain modifications.

Session II: FINANCIAL NEEDS

Financing Fisheries Sector—Experience of Syndicate Bank

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ABSTRACT

Syndicate Bank has played a dynamic role in assisting the fishermen community and the fisheries industry in Karnataka. The Bank's balance outstanding against mechanised fishing boats as on September 1985 was 805.97 lakhs of which Rs. 402.59 lakhs was in arrears. Adjustment of repayments towards insurance, CGC commission and interest, phenomenal increase in the number of boats, decline in catches, steep increase in cost of diesel oil, escalation in the cost of boats and nets, poor marketing arrangements, dispute among partners and the system of paying 30% catch value to crew members contribute to the poor recoveries of loans. Several measures have been suggested to improve the situation. These include diversification of fishing, bringing wilful defaulters under Karnataka Public Money Recovery Act, extension of repayment period from 5 to 8 years, dispensing with DICGC premium, maintenance of present fleet size by not issuing feasibility certificates with respect to purse-seine and gillnet boats, strengthening Karnataka Fisheries Development Corporation snd South Kanara District Cooperative Fish Marketing Federation to take up Marketing of catches from mechanised boats and compelling mechanised boat owners to market through these agencies, providing facilities for explioting off-shore resources and encouraging medium sized mechanised outrigger trawlers.

Karnataka is one of the important maritime states in West Coast comprising of 2 coastal districts namely Dakshina Kannada and Uttara Kannada. These two Districts have about 300 Kilometres of coastal line with fishermen population of about 1,20,000 of which 60,000 are directly engaged in fishing activities. Use of mechanised fisning boat has shown appreciable increase in the landing of marine fish catches and a large number of mechanised boats are profitably used for catching shrimps and pelagic fishes.

Syndicate Bank has good net work of branches in two coastal Districts of Karnataka. The Bank had taken the lead in financing purse-seine boats, out rigger trawlers and small fishermen Rampani/Pattebale groups.

I. Developmental Role:

a. Financing Rampani/Pattebale Groups:

In Karnataka there are number of Rampani and Pattebale groups traditionally engaged in catching pelagic fish. The average income of each fisherman under the above two methods of fishing ranges from Rs. 2000/– to Rs. 3000/–. With the introduction of purse-seine boats on Karnataka Coast for pelagic fishes, the Rampani/Pattebale method of fishing has become uneconomical. With a view to improving the economic condition of these traditional fishermen the bank financed schemes benefiting these fishermen for the purpose of purse-seine boats. The bank in collaboration with the Government of Karnataka took efforts to organise Rampani/Pattebale fishermen for acquiring purse-seine boats. For operational convenience Rampani/Pattebale groups were initiated to organise themselves into a registered partnership firm with about 17 to 20 selected members constituting a firm. The Bank and Department of Fisheries assisted and guided them in procuring Hull Net and on various accounting procedures.

b. Financing Malpe Fire Victims:

To the fishermen of Karnataka and for the fishing industry as a whole 19th July 1979 was black day, for, there took place a fire accident at the Malpe Fishing Harbour. It was a sight which whoever saw will not forget in their life time. As per the survey conducted by the Department of Fisheries about 214 fishing crafts of different sizes were lost in the fire accident and the loss incurred was to the extent of Rs. 2.20 crores. Our Bank took lead in convening a Banker's meeting to discuss the re-habilitation measures such as early settlement of insurance claim, sanction of fresh loan at concessional rate of interest, sanction of subsidy by the State Government, supply of engines, Hulls on priority basis for the Malpe Fire Victims. As a result of quick follow up action taken by the Bank at various levels all the fire victims could continue their fishing operation in the immediate next fishing season by procuring new craft with insurance claim amount and fresh Bank Loan at consessional rate of interest. Syndicate Bank has provided financial assistance to the tune of Rs. 152.565 lacs. Our Bank's significant work done in rehabilitating the Malpe fire victims reflects the Bank's role played in developing the economy of the region keeping in view the poorer sector of the community.

c. Registration of Boats:

With a view to facilitate registration of mechanised fishing boats and to note the lien, Bank has suggested to MPEDA Cochin to open their Regional Office in each Maritime State. Recently MPEDA Cochin have opened their Regional Office in many States. This has helped the Fishermen to register their Boats, and note the charges regarding transfer of boats, noting of Bank's lien and movements of boats.

d. Research Study on Fisheries Industry:

Fishing is one of the important economic activities of Karnataka State. With a view to develop the marine fisheries in a systematic way Syndicate Bank has commissioned T. A. Pai Management Institute, Manipal to conduct a study of problems and prospects of marine fisheries development in Karnataka. The institute has conducted the study and published their interim report indicating the problems and suggesting remedial measures to exploit the Fishery resources in a systematic manner. The final report of the above study will be published shortly. It is hoped that the findings of the study will be very useful for taking policy decisions for further development of the industry.

e. Collaboration with National Institutions:

The Bank has also associated with AFC, IDBI and NABARD in conducting various studies on infra-structural facilities connected to fishing industry. This has helped the financing institution to clear the schemes benefiting fishermen under re-habilitation measures.

f. Maritime broadcasts:

Syndicate Bank suggested to Akashavani Mangalore to broadcast the information about the availability of fish at different landing centres, marketing aspects and climatic condition. This information would enable the fishermen to move the boats to the potential ground and conduct fishing operation profitably. Consequently Akashavani Mangalore has been broadcasting the information about the weather conditions at 10-30 PM every day. It is hoped that Mangalore Akashavani will arrange to give additional information on availability of fish catches and prevailing rates at the various landing centres. The bank had suggested to Department of Fisheries to provide the necessary information to Mangalore Akashavani in this regard.

g. Concessional rate of Interest:

With a view to extend concessional rate of interest to traditional fishermen, Bank had requested NABARD to treat Rampani/Pattebale fishermen as small fishermen (in par with small farmer). NABARD has agreed to treat the Rampani/Pattebale fishermen and released refinance at 6.5% interest. The Bank had extended this benefit to Rampani/Pattebale fishermen.

h. With a view to equip our traditional fishermen to undertake deep sea fishing, the bank had submitted a proposal for group study programme for Karnataka fishermen in Scandinevian countries. It appears that the Government of Karnataka has submitted the proposal to Government of India for clearance. It is hoped that the above proposal when cleared will enable the fishermen to exploit the off-shore resources by operating sophisticated deep sea trawlers.

II. Experience in Financing:

The Bank has been implementing numerous schemes benefiting fishermen for the following purposes:

a. Marine Fisheries:

1. Country crafts
2. Mechanised Gillnet Boats.
3. Mechanised Trawler Boats.
4. Mechanised Purse-seine boats.
5. Mechanised carrier boats.
6. Mechanised outrigger Trawlers.
7. Mechanised Deep Sea Trawlers.

b. Infra-structure for fishing industry:

1. Ice plants.
2. Cold Storage & Freezing Plants.
3. Canning Plants.
4. Fish Meal Plants.
5. Fish Transport operation.
6. Assistance to fisherwomen for processing activity (Salting & Drying).
7. Fish Merchants.
8. Workshop for effecting repairs.
9. Suppliers of Net and spare parts.

The Balance outstanding against mechanised fishing boats as on 30–09–1985 works out to Rs. 805.97 lacs as per Table 1. Out of Rs. 805.97 lacs, a sum of Rs. 402.59 lacs is arrears. With a view to ascertain the reasons for mounting overdues and evaluate the performance of various schemes, the bank has conducted studies in D.K. and U.K. Districts.

The reasons for high percentage of overdues may be attributable to the following factors:

1. A lion's share of the repayments made is being adjusted towards insurance, CGC Commission and Interest.
2. The phenomenal increase in the number of boats has adversely affected per boat catches.
3. Mackeral and Sardine accounts 60% of the purse-seine boats catch component (landings). The disappearance of these shoals in most of the periods during the last 3 fishing seasons affected the income of purse-seine boats.
4. There is a steep increase in the cost of diesel oil over the years. The cost of diesel per litre which was Rs. 1.80 in 1978 shot up to Rs. 3.80 to-day. This has decissive impact on the operational cost of mechanised boats.
5. According to the prevailing practice in Karnataka 30% of the value of the catches is to be paid as the share of crew, whereas in other states the crew is being appointed on fixed salary basis. As per the estimate made by us, the crew share and diesel oil expanses account for more than 60% of the

Table 1. Statement Showing Balance Outstanding against mechanised fishing Boats as on 30–9–1985

Division	No. of Branch	No. of A/Cs	Original Advance	Balance outstanding	Recoveries			Arrears
					From the date of loan to the date of reporting	During the previous season	During the current season	
Purse-seine Boats:								
Mangalore	11	45	130.25	115.51	96.15	15.40	9.71	51.92
Udupi	21	88	294.80	336.80	169.98	17.80	23.02	187.20
TOTAL	32	133	424.59	452.31	265.13	33.20	32.73	239.12
Other-than Purse-seine Boats:								
Mangalore	11	85	59.17	58.23	32.03	4.98	5.11	30.42
Udupi	26	446	268.35	294.45	151.15	18.09	13.25	133.05
TOTAL	37	531	327.52	353.68	183.18	23.07	18.36	163.47
GRAND TOTAL	48	664	754.11	805.99	448.31	56.27	51.09	402.59

total operational expenditure of a boats.

6. The escalation in the cost of boats reflected in the amount borrowed and interest payable by the borrowers.

7. Purse-seine is one of the highly expensive fishing gears. Most of the purse-seine boat owners have invested huge amount i.e. Rs. 30000/– in each year of the purchase of additional quantity of net. Since the purse-seine operation has been highly competitive each purse-seine should have at least 1500/1600 kgs. quantity of net. As the bank has considered loan for the purchase of 1000 Kgs. of Net, the borrowers have been compelled to purchase additional net out of the income derived. The above expenditure affected the recovery position.

8. Those who have got adequate income diversified the amount without meeting the Bank Committment.

9. Poor marketing arrangements and non-receipt of fish sale proceeds from various marketing agencies towards repayment of loans. During the field study, it was observed that a huge sum is pending with the marketing institutions. Due to delayed payment by the buyers the marketing institutions, could not effect payment to the branch towards the respective loan accounts.

10. Disputes among the groups and thereby considerable reduction in the operational days. Transfer of boats and payment of huge amount towards the share of outgoing partners have also affected the recovery of boat loans.

11. Inadequate follow-up action at the branch level to recover the boat loan is also responsible for the mounting of overdues.

III. Suggestions for Improvement:

The measures indicated below will go a long way in sustaining this sector during the coming decade.

1. At present the purse-seine boats are concentrating mainly on catching pelagic fish viz. Mackerel, Sardine etc. It is reported that the appearance of these types of fishes is confined only during certain period of fishing season. In times when these fishes are not available either the purse-seine boats should remain idle or their operations will not be economical. In order to make purse-seine boats more economical, it is desirable to diversify their operations to trawling operations for catching demersel fishes like prawns. This will enable the purse-seine boats to earn more income. To fecilitate the purse-seine boat owners to takeup trawling operations, the possibility of extending financial assistance for the purchase of trawl nets and storage fecilities may be considered by the Banks.

2. Fisheries advances require close follow up and supervision. Our experience reveals that even the 10% of the borrowers who have got good catches have diversified their earnings without meeting their committment to the Bank. To ensure close supervision and follow up, the officials of fisheries Department may also be involved. With a view to take stern action against wilful defaulters, Karnataka Public Money Recovery Act may be made applicable to all types of mechanised boat loan accounts.

3. According to the present practice repayment of the loan has to be made one month after commencing the fishing operations. In view of the fact that the value of one month catches will not be sufficient to repay the accrued interest, insurance premium, DICGC Commission, instalment which works out to a huge amount, the bank has decided to fix Ist Instalment after 3 months instead of present one month, of starting the fishing operations.

4. Applying the norm of average catches of Rs. 4.00 lacs per year, it will be impossible to clear a purse-seine boat loan in 5 years. To help the fishermen on the one hand and to reduce the incidence of overdues on the other hand, the Bank has considered the extension of repayment period from 5 years to 8 years. It may be mentioned here that Bank had taken up the matter with NABARD and NABARD has agreed to allow a repayment period of 8 years.

5. During the Field Investigations and discussions we had with Government authorities, we learn that the life span of purse-seine boat is about 15 years. In the case of some of Boat advances even after lapse of 5 years, the amount outstanding is more than the amount advanced. In these cases, even if the repayment period is extended, the borrowers will not be in a position to clear off the loans. In such cases, the Bank has given a fresh repayment period of 5 years. However, Bank has taken the care not to allow this facility to the wilful defaulters.

6. The boats are covered under Insurance against Marine risk partial as well as total loss. Towards the insurance

premium each purse-seine boat borrower has to pay an amount of Rs. 15,000/20,000 per year. Assuming that repayment period of loan is 7 years, a borrower has to pay a total amount of Rs. 1,00,000 to 1,25,000 as insurance premium. (The premium amount has to be paid on the full value of the boat) in cases of total/ partial loss, the bank will get reimbursement from the Insurance Company. In this sense the bank loan is fully secured. In addition to this coverage, at present Bank is insisting the borrowers to pay DICGC premium at the rate of 3/4% of the total loan amount/outstanding balance which work out to Rs. 25000/– on an average during the currency of the loan period.

In respect of DICGC, the maximum amount which the Bank will get in case the loan is considered as bad or doubt full of recovery is only Rs. 37500/--. In case of defaulted loan, when the borrower takes longer repayment period to repay the loan, the amount payable to DICGC is much more than what we get from them. The borrowers have represented why they should pay DICGC premium when the boats are covered under insurance. Another drawback of DICGC is that it makes no distinction between regular and irregular clients. In respect of borrowers who pay their loans regularly it is a sheer waste, whereas in the case of defaulters it is an additional burden since the boats are covered under Marine insurance and in case of wilful defaults we are having the physical asset to fall back upon to recover our dues, we suggest that insistance to pay DICGC premium on mechanised trawler and purse-seine boats may be dispensed with. This aspect may be taken with IBA and DICGC authorities and payment of DICGC in respect of boat loans may be left to the option of the Bank.

7. Karnataka is having highest number of mechanised trawlers purse-seine boats and gillnet boats. Our studies indicate that average catch per boat has come down. Hence the department of fisheries may stop issuing feasibility certificate and the present fleet size may be maintained for a period of 10 years.

8. With a view to avoid dispure among the fishermen engaged in different types of fishing, demarcation of fishing zone for different types of boats may be made and enforced strictly.

9. During the field study it was informed that decline in cathes is due to fishing in monsoon period and using wrong sizes of Mesh. The Department of fisheries may take action to stop fishing in breeding period and educate the fishermen to use standardised mesh size.

10. M/s Karnataka Fisheries Development Corporation Ltd. and S. K. District Co-op. Fish Marketing Federation Ltd., Mangalore may be strengthened to take up marketing activities of mechanised fishing boats and mechanised boat owners may be compelled to market the fish catches through these institutions.

11. The improvement of the socio-economic conditions of the traditional fishermen call for their greater involvement in the process of modernisation of fishing industry. The traditional fishermen must be offered opportunities for helping the country to exploit the fisheries resources, particularly the off-shore resources

which have not been adequately harnessed, in the next few years. Unless this is done, the off-shore fishing will remain a preserve of big business houses and entrepreneurs who have a command over capital resources.

12. There are about 40 skippers from Karnataka working for big companies managing deep sea trawlers in the east coast. A few skippers have approached our Bank to provide financial assistance for the purchase of outrigger trawlers. The Bank had provided financial assistance to these skippers for acquiring medium size mechanised out rigger trawlers. The Bank's experience with these type of boats is satisfactory. Hence the department may plan to introduce such boats in our coast in a phased manner.

IV. Impact of Bank's Lending:

Our study revealed that under the various schemes implemented by the Syndicate bank, the fisherman is able to earn Rs. 5000/- to 6000/- per annum. The scheme has also helped to provide employment to 5,000 Small fishermen and 10,000 persons indirectly in the process of marketing, transporting, freezing/processing and other ancillary industries. The operation of purse-seine boats by Rampani/Pattebale groups has reduced the dispute between traditional fishermen and mechanised boat owners. On review of records, we observe that about 200 mechanised trawler boat parties and 60 purse-seine boat parties have cleared their loan account during the last 10 years.

The fishermen generally lack banking habits. Whenever they get surplus funds, they are likely to divert funds for different purposes. Personal contacts of the individual fishermen is very important during peak fishing period. The officials stationed at the branch level constantly visit the landing centres during the peak fishing period, watch the movements of the boats and record the particulars of fish catches landed at various landing centres. The Bank has also made tie-up agreements with Marketing institutions to remit certain percentage of value of fish marketed by the mechanised boast. With the above arrangements, bank has recovered sizeable amount towards recovery.

Conclusion:

The foregoing account reveals the dynamic role played by Syndicate Bank to assist the fishermen community and the fisheries industry in Karnataka. It would be no exaggeration to say that the Bank has contributed substantially to the modernisation of the fishing industry and in improving the socio-economic conditions of thousands of fishermen families. However, the Bank is not fully satisfied with the progress. The developments of the industry would have been much more significant if the industry and the fishermen had responded more positively to the liberal measures of assistance offered by the Bank. The Bank would like to see better Banking habits developed among the fishermen and a greater sense of responsibility towards meeting their repayment committments. A better rate of recovery will encourage the Banks to finance the fisheries industry in a more vigourous manner.

In the immediate future, a well co-ordinated effort involving the fisheries industry, Fisheries Department of the Government, Fisheries College, the financing Banks, KFDC and Fish Marketing Federation is very much called for so that the industry continues to progress on right lines. It is hoped that all cencerned will work in this direction.

Financing Fisheries Sector—Experience of Corporation Bank

K. AJIT RAO

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ABSTRACT

Corporation Bank has been financing fisheries sector since 1971–72. Finance has been extended to purchase of purse-seine, trawl boats/nets, gillnets and deep sea fishing vessels. As on Iune 30, 1985, a sum of Rs. 363.43 lakhs is outstanding in this sector of which 57% is overdue. Recovery percentage with respect to loans extended has been showing a declining trend during last three years. Wilful default on the part of fishermen borrowers is suspected to be the main reason for poor recoveries. Banks are ill equipped to proceed against wilful defaulters. MPEDA which is issuing registration certificates to boats, does not have control over movement of boats, sale of boats, etc. and legislation regarding compulsory registration of mechanised boats with Department of Fisheries and issue of fishing licence is urgently called for. Lack of support price for fish, marketing arrangements and catch data are other problems. For sustaining the industry a number of suggestions have been made like introduction of multipurpose vessels, providing alternatives to wood in boat construction, reduction of operational costs, deep sea fishing and brackish water farming.

Corporation Bank has been financing fisheries sector even as early as 1971–72. Our major finance in this field at that time was through our Malpe branch situated right on the sea-shore. The no. of boats financed then were about 10 small sized trawl boats between the period from 1971 to 1975. The other branches situated in the coastal areas also started financing for acquisition of boats and for the first time in our Bank in 1976 a comprehensive area development scheme for financing 10 boats through our Coastal branches like Malpe, Mangalore, Coondapoor, Manur, etc., was proposed. A similar scheme covering the branches of North Kanara District like Bhatkal, Kumta and Karwar was prepared in 1977. By then the Dept. of Fisheries advised the banks to go slow in financing trawl boats and requested them to restrict financing towards the replacement of old boats only for which feasibility certificates were to be issued by the Dept. of Fisheries However, Banks were requested to extend finance for acquisition of purse-seine boats. Therefore two area development schemes of 10 purse-seine boats each covering the South Kanara and North Kanara Districts was prepared and the required financial assistance was extended to the eligible groups of fishermen during 1977 and 1978. However, the craze for purse-seining also dwindled subsequently and a few individual schemes were financed by us in the subsequent years.

There was a devasting fire at Malpe on 19-7-79 destroying about 196 machanised boats in all. As a rehabilitation measure of the victims affected by fire, we extended financial assistance for acquisition of about 24 boats under the soft loan scheme from IDBI during 1980 and 1981.

During 1982 and 1983, the Govt. of Karnataka formulated a scheme for the benefit of traditional group fishermen i.e. the groups of fishermen who were earlier operating the Rampani and Kairampani gears and whose profession was seriously affected by the purse-seine fishing. As per the scheme about 30–35 families were to be

identified in each group and given subsidy assistance from DRDS @ Rs. 3,000/– per family and the banks were required to extend finance for purchase of purse-seine boats. We extended finance for 8 such units under the scheme in South Kanara District.

In North Kanara Dist., a similar scheme for purchase of gillnetters was prepared by the Govt. and we extended finance to about 40 units under the scheme.

At present we are continuing to finance for acquisition of trawl boats towards replacement of old boats and gillnetters only as the Govt. has introduced a ban on financing of new purse-seiners.

During 1984 we have also entered into the area of financing of deep sea fishing in Karnataka. In consortium with other bank and refinance assistance from NABARD, we have extended finance for import of a second-hand deep sea tuna fishing vessel from Japan for tapping the tuna fishery resources of our Coast. The performance of this vessel is yet to be assessed as the unit has run into some teething troubles.

The present position of our advances to the development of fisheries as on 30th June 1985 is furnished below:

Table 1. Review of advances to development of fisheries in Karnataka State as on 30–6–85—Performance of Corporation Bank [Rs. in lakhs]

Sl. No.	Type of activity	No. of units financed	Total loan sanctioned	Total amt. disbursed	Amt. outstanding as on 30-6-85	Total demand	Collection	Balance (Overdues)	Overdues %
1.	Purse-seine boats	28	114.14	113.59	82.17	78.90	32.30	46.60	59
2.	Trawl boats	116	120.24	118.40	100.69	65.13	26.05	39.08	60
3.	Gillnet boats	51	17.94	17.80	14.50	8.93	2.73	6.25	70
	Country boats, nets & other misc. items for fisheries sector	587	31.71	32.69	25.37	9.76	5.05	4.71	48
5.	Fish processing activities such as freezing plants, canning industries, fish meal plants, salting, drying, curing, yards etc.	13	96.29	96.29	68.57	49.44	28.62	20.82	42
6.	Deep sea fishing	1	66.69	66.69	72.13	7.87	—	7.87	100
		796	447.01	445.46	363.43	220.03	94.75	125.33	57

Problems observed in financing marine fisheries schemes:

The major problem observed is the poor recovery performance of the loans in this sector. The recovery percentage in respect of the loans extended by our Bank in Karnataka State during the last 3 years is furnished below. (Table 2).

It could be observed that the recovery percentage is coming down year by year eventhough the Bank finance to this sector is increasing year after year. The increases in recovery percentage observed as on 30–6–85 in on account of rephasement and extension of repayment periods of majority of the loans. The recovery percentage of some of the Banks operating in D. K. Region for the year 1984 is furnished in table 3.

Therefore, bankers are viewing this sector with circumspection and this does not speak well from the point of view of further growth in this sector. In the opinion of the Bankers, the main reason for such a heavy overdues position is wilful default on the part of fishermen borrowers. The speculative nature of the industry provides the borrower enough grounds to escape regular repayments and to clamour for extensions/subsidies and writeoffs.

Table 2. Recovery percentage position of the various types of fisheries loans

Type of Boat	Years (as on 30th June)				
	1981	1982	1983	1984	1985
Purse-seine boats	60	61	43	27	41
Trawl boats	36	38	29	20	40
Gillnet boats	—	77	52	21	30
Others (country boats, etc.)	62	56	50	45	52

Table 3. Fishing loan as on Dec. 1984 in D. K. Dist. of major Commercial Banks

[Amounts in 000's]

Sl. No.	Name of the Bank	Total loan outstanding	Total demand	Total recovery	Total overdue	% of overdues to demand
1.	Syndicate Bank	68885	54072	11866	42206	78
2.	Canara Bank	23312	20729	5891	14838	72
3.	Vijaya Bank	9823	6989	1065	5924	85
4.	State Bank of India	12600	12519	1510	11009	88
5.	Karnataka Bank Ltd.	7719	4437	887	3550	80
6.	Indian Overseas Bank	143	87	6	81	93
7.	Union Bank of India	1110	292	82	210	72
8.	Bank of Baroda	1093	1278	698	680	53
9.	Dena Bank	303	186	41	145	77
	Total	124988	100589	22046	78643	78

No doubt that the fisherfolks suffered during the periods of poor catches. It is also true that the crowded fleet and cost escalations have hurt the viability of the boat operations. Nevertheless it is our experience that many of the borrowers who have earned good surplus in good fishing seasons, have diverted the funds for other purposes. We feel sorry to state that those fishermen who make a hue and cry when fish catches are poor keep quiet when the going is good. The nature of fishing operations is such that the bad fishing season is always inter-mixed with the good fishing season and therefore we are not in a position to resort to the conventional steps available for the recovery of our dues. Further, organisationally speaking, we in the Banks are ill-equipped to proceed against wilful defaulters. Eventhough at times we seize the boats by resorting to legal action, we find practical problems in safe keeping of the vessel, etc., and therefore resorting to legal action becomes difficult. Generally we try to avoid such steps which in turn motivates even the other good borrowers to default.

Further, lack of statutory regulations in this sector has worsened the situation. At present MPEDA is registering the boats by issuing a registration certificate with the lien notings of the financial institutions. No further action is taken by MPEDA and MPEDA does not appear to have any control on the movement of boats, sale of boats, thereby Commercial Banks are not in a position to refer to MPEDA whenever they require any help and assistance in seizing of boats, etc. This leads to lot of malafides in this sector such as unofficial change of ownership of the boats, unwritten partnership among fishermen, movement of boat from Karnataka to Kerala or Goa, etc., without the knowledge of the financing banks. Bankers are kept in the dark about these and come to know about this only at a later date. It is, therefore, very much essential that the Karnataka Govt. should bring-in a legislation making it compulsory for the registration of the mechanised boats with the Dept. of Fisheries and issue of fishing licences so that the fisheries Dept., will have more control over them.

Some of the other related problems faced by the fishermen and which have a direct bearing on the recovery of loans are enumerated below:

1. **No support price for fish:**

   Fish catches are subjected to the vagaries of nature and comes either in plenty or scanty. When the catches are plenty price goes down and vice-versa. Fish being a highly perishable commodity, has to be sold for a throw-away price if there is no demand. There is at present no arrangement for fixing a regular price for fish except prawns which has got high export value. This should be looked from the point of better returns to the fishermen.

2. **No infra–structures/marketing arrange ments:**

   At present there is no organisational marketing structure for fish in Karnataka. Marketing Federations to a limited extent for prawn catches and Karnataka Fisheries Devt. Corporation for purse-seine catches are doing the marketing at present. However, marketing through these organisations is not compulsory and majority of the boat owners do the marketing directly. If the marketing of the catches is made compulsory through the organised agencies, bank would be able to link the recovery of loans with such marketing agencies

by asking them to send a portion of the returns directly to the Bank and also the catch particulars for verification. This not only helps the bankers in the recovery of the loans, but also for rephasement and providing concessions to the genuine defaulters.

3. **Maintenance of fish catch register:**

Fishermen must be educated to maintain the fish catch register with them and they should enter their daily fish catch and other particulars in it. This helps the bankers for proper follow-up of loan accounts and to effect prompt recovery of the loans.

Future Prospects for Karnataka Fisheries:

In the light of the foregoing discussions it is evident that the future for marine fisheries in Karnataka is very dim. The industry can sustain to the extent of replacement of the outgoing fishing vessels which is only marginal.

As a measure of sustaining the growth of the industry, the fishermen could do well to diversify the existing fishing gears. For example, the trawlers introduced for catching prawns remain idle during the season of non-availability of prawns. In spite of this, as there is heavy demand for prawns for export, more number of small trawlers are being introduced resulting in over-exploitation of prawn fishing grounds in the inshore waters leading to non-financial viability of these boats. This has made the fishermen to go in for a totally new type of gear i.e., purse-seine which was introduced in 1975. This was a great success during the initial few years. However, the no. of purse-seiners are also now saturated and any more investment in this sector is not viable. Therefore, the Karnataka Fisheries at this stage requires diversification such as;

1. **Multipurpose vessels:**

Vessels which could employ purse-seine, trawling, longlining and gillnetting in the off-shore area upto 60–70 m depth during the peak season for each type of fishery. This avoids idling of the vessel during seasons as is the case presently and returns will be also better to make the scheme economically viable.

2. **Reduction in the capital cost:**

One of the main reasons observed which is affecting the commercial viability of the mechanised boat, is the high escalation in the capital cost especially the cost of the hull due to steep increase in the cost of wood in our country. Lot of importance has to be given for research and development for manufacture of boats with alternative materials such as Ferro-cement/Fibre glass at cheaper rate or alternatively with extended economic life. This will result in the future of the mechanised boat scheme become more economically viable.

3. **Reduction in operational costs:**

It is observed of late among the fishermen of Mangalore Coast that the double night and trible night fishing is becoming more popular by employing wooden boats of 34'–36' size with fish hold and thermocoal ice boxes. This reduces the operational costs as to and fro fuel expenses to reach the fishing ground everyday is avoided. More scientific studies should be undertaken to suggest better designed boats for this purpose and extension education should be given to the fishermen to go in for more and more this kind of boats.

4. **Deep sea fishing:**

For catching the potentially available

fish upto 100 fathoms depth in the EEZ of the country especially tuna fishes which are available in plenty in the West Coast around Lakshadweep island near to the Karnataka Coast, the deep sea tuna fishing vessels should be encouraged. These are required to be taken up by the big entrepreneurs and Govt. since the fishermen of our coast lack the technical skill and entrepreneural ability required for the purpose. It would be advisable to go in for collaboration with the advanced fishing countries so that in the next few years we will be able to have adequate no. of deep sea vessels in our state and also acquire the requisite skills to man and operate the same. Since we do not have adequate data regarding fishery resources in the deep sea waters, the Govt./Research Institutions should come forward for extensive survey and thereby luring the enterpreneurs to go in for this kind of fishing.

5. **Brackishwater farming:**

This could be considered as an extension of the Marine Fisheries as we are yet to develop mari-culture on commercial basis. Since Karnataka coast is already overexploited and saturation point has been reached with regard to the prawn landings, Karnataka has to develop supplementary sources to augment the supply of prawns. Brackishwater fish culture for prawns offers good scope for the same as Karnataka has 8000 sq.kms. of brackishwater area.

Conclusions

To conclude, it could be mentioned that Karnataka which claims credit for having changed the fishing scene from man to machine without tears is on the threshhold of another leap from off-shore to deep sea. It is hoped that such change comes out soon for the better and sustaining this sector in the coming decade.

Financing Fisheries Sector—The Experience of Karnataka Bank

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ABSTRACT

Fishing boat advance constitutes about 10% of agricultural advances by Karnataka Bank. As on June 1985, Rs. 1.54 crores have been advanced for fishing boats/nets. But the overdue position is about 62%. Most of these advances are lent to partnership firms and change of partnership and sometimes even change of ownership without the knowledge of the financiers affect the loan repayments. Difficulty in getting fish/prawn catch statements either from borrowers or from marketing agency is another bottleneck in the recovery process. It is suggested that commercial banks could diversify lending to fish processing and fish marketing under various schemes like Integrated Rural Development Programme (IRDP), self-employment scheme, etc.

The Karnataka Bank started financing mechanised fishing boats as early as in 1967. At present our fishing boat advances are about 10% of our agricultural advances. As on 30-06-1985 the fishing boats advance is Rs. 1.54 crores for 300 boats comprising of 31 purse-seine boats, 48 trawlers, 6 gill-nets and about 205 country boats/nets. Our overdue position is about 62%.

It is clear from the above data and from the experience of other financial institutions shared during various meetings that the recoveries in these types of advances are not encouraging for further advances.

Majority of these advances are lent to partnership firms of 5–6 partners. In almost all the cases, after 2–3 years of operation disputes arise among partners. By their oral consent one or two out of 5 or 6 partners will try to manage the affairs of boat for certain period. Afterwards the management will be changed to other partners. In all the cases one set of partners blame the other for having mismanaged the accounts of the firm and diversion of funds.

Another common feature noticed is change of ownership without the knowledge of financers. In these cases when the question of repayment of loans comes, the actual borrower tries to put the blame on the third party to whom he has given the boat for operation under their private agreement.

There is a feeling that the fishing boat advances are charged higher rate of interest and interests are compounded. On the other hand, the fishing boat advances are lent under concessional rate of interest, i.e., 12.5% whereas the normal rate of lending at present is 17.5%. There is also a wrong notion that penal interest and compounding of interest are done to fishing boat advances against the norms. However it may be noted that the penal interest and compounding of interest can be charged when the instalments become overdue as per the existing guidelines.

Other reasons for poor recoveries are: (1) Poor fish/prawn catches, (2) Hike in diesel and operational cost of boats, (2) Lack of proper tie-up arrangements in marketing. This last factor is not fully accepted by marketing agencies of fish/prawns and they are of the opinion that commercial banks should strengthen their recovery team. We desire to make it clear that branch managers and field officers of our bank pay visits to landing centres, keep personal contact with the borrowers besides

having obtained letters of undertaking from the borrowers to market their catches through the concerned marketing agencies. The consent letters are forwarded to marketing agencies to send us the 30% of sale proceeds of catches to our loan accounts. However we are finding difficulty in getting the fish/prawn catch statements either from borrowers or from marketing agencies. We are therefore, not in a position to assess the actual position and this weakens our recovery process.

Deep-Sea Fishing:

About 99% of marine fish catches come from those boats fishing in inshore water areas where production has reached near saturation point and only 1% is contributed by deep seas. Thus most of the potential of the exclusive economic zone which spans upto 200 miles remains idle. Deep sea fishing is not yet fully developed in this country for reasons best known to all. This being a highly capital intensive venture, without much knowledge on fishing grounds of high potential, the entrepreneurs hesitate to take up this risky venture. Another constraint in the development of deep sea fishing is the orientation of our markets. It is observed that the Indian consumers' preferences for deep sea varieties of fishes is very low compared to inshore varieties. Efforts should, therefore, be made through processing technology and modern marketing methods to popularize these varieties among consumers. At present trawlers of 32′–36′ and purse-seine boats of 43′–45′ (maximum upto 48') are generally employed by our fishermen engaged in fishing in near shore waters upto 40 fathoms. A beginning may be made by government departments/ research institutions to launch bigger trawlers of 40′–50′, purse-seiners upto 60′ and find out the fishing results in our seas of 40–60 fathoms depth. The encouraging results will attract our fishermen/entrepreneurs for more and more such medium/ large fishing fleets in the near future to augment our fishing wealth. The above suggestion can be taken up in view of the failure of attempts made by few leading multinational companies engaging still bigger deep sea trawlers/purse-seiners.

Diversification in lendings:

It is our view that commercial banks should think on diversification of lending in marine fisheries sector. There are large number of government sponsored schemes where commercial banks have greater role to play in lending to weaker sections of people. Instead of concentrating only on financing trawlers, purse-seiners, gillnetters and country boats in marine fishing sector, efforts should be made to finance other type of fishing, processing of fish products, fish marketing etc. under Integrated Rural Development Programme (IRDP), self-employment scheme for unemployed educated youths, Anthyodaya, Munnade, Gruhakalyana, Sagar Deepa etc. For example, canoe-purse-seining, production of salted fish, dried fish, fish pickles, chakkulies, sevu, wafers, jams, minced fish meat, fish protein concentrate, fish meal, marketing of fresh fish by local fishermen, dried fishes by private entrepreneurs etc.

The production programme and marketing should be streamlined and bankable schemes formulated to suit these national programmes. In the absence of complete and detailed guidances of such bankable schemes, finance to fishing business, new type of fishing methods, processing of products under the various schemes will not be easily available; hampering the growth of this industry to a large extent. The fisheries scientists, research institutions, planners and administrators may have to focus their attention on this in their extension programmes in collaboration with financial institutions.

Financing Fisheries Sector–Experience of Karnataka State Finance Corporation

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ABSTRACT

Karnataka State Finance Corporation has so far assisted purse-seiners, trawlers, ice and cold storage plants and small boats to the extent of Rs. 304.08 lakhs. The performance of the industry has been far from satisfactory and the Corporation has considered rescheduling of loans with respect of defaulters and in respect of sick units, additional loan terms have been granted by way of rehabilitation assistance.

Fishing Industry in Karnataka:

Marine fisheries are confined to the coastal areas of Karnataka consisting of Dakshina Kannada and Uttara Kannada districts. There are about 400 purse-seiners, 1930 shrimp trawlers and 550 gillnetts operating in D.K. and U.K. Districts.

The marine fish production for the years 1982–83 to 1984–85 is given below:

The demand for marine fish broadly consists of deomestic and export demand. The domestic demand is made up of that for human consumption which includes household purchases in small lots and bulk purchases. The industrial use of marine fish is mainly for preparation of fishmeal fish oil, solubles and fish concentrates. The main use of these by-products are cattle and poultry feed units and pharmaceutical industry.

Karnataka has a very good fishery potential with about 350 km. of coastline which is about 25,000 sq. metres of continental shelf where marine fishing can be undertaken. That part, there is about 8000 hectares of Brackish water resources and about 4 lakhs hectares of inland fishing resources. An optimum exploitation of all these resources by the fishermen of the State is necessary to increase income of the State and even valuable foreign exchange through exports. For this purpose, the State Government has planned to spend substantial amount on Fish Farms, Hatcheries, Research, Training and Development of Inland Fisheries, Riverine Fisheries, Deep-Sea Fisheries and Improvement of Fishing Harbour, Ports etc. Similarly, the State Fisheries Corporation has also programmes to encourage deep-sea fishing through joint ventures by chartering of sea vessels from abroad and also encouraging mariculture and brackish water fishing.

Year	Quantity (M.T.)		State Total	% to State Total	
	Dakshina Kannada	Uttara Kannada		D.K.	U.K.
1982–83	76054	28001	104055	73	27
1983–84	68909	35381	104290	66	34
1984–85	128607	39439	168046	76.5	23.5

The State Government is encouraging deep-sea fishing by acquiring 'Bull-Trawlers'. There is good scope for deep-sea fishing. As against Karnataka's, 350 kms. coastline, deep-sea fishing is done only in 24 kms. As a result of this limited fishing zone, too many boats are operating in a small area. Hence, the deep-sea fishing has become quite necessary to fish in entire 350 kms., area.

Karnataka has organised good market facilities for the fisheries through the Karnataka Fisheries Developments Corporation and Fisheries Federation of Dakshina Kannada & Uttara Kannada. There are 222 Fisheries Co-operative societies with a membership of 60,489 in the State. Of these, Dakshina Kannada has 42 Co-op. Societies and Uttara Kannada 30 co-op. Societies. There are 43 fish markets in our State. Dakshina Kannada and Uttara Kannada each have 12 fish markets.

Role of Karnataka State Financial Corporation:

Karnatak State Financial Corporation was established in 1959 by the State Government under SFC's Act 1951, with the principle objective of promoting entrepreneurship in the small and medium scale industrial sectors in the State of Karnataka. Its objectives are manifold like dispersal of industries to backward areas, systematic and balanced growth of industries in the State, tapping of entrepreneural potential and local resources. It promotes innovative and high technology projects in the State. It can assist upto Rs. 30.00 lakhs to proprietory and partnership concerns and upto Rs. 60 lakhs to companies and registered societies. The Corporation has assisted in a big way to the Fishery sector.

Assistance to Fishing Industry:

KSFC has so far assisted 23 purse-seiners cum trawlers to the extent of Rs. 89.40 lakhs, 9 Ice & Cold Storage Plants to the extent of Rs. 49.92 lakhs and 113 loans to small boats amounting to Rs. 164.76 lakhs in N. K. and S. K. Districts.

The performance of fishing industry as compared to other type of industries assisted by us is far from satisfactory. The main reasons assigned for this poor performance are: (1) poor catches of marine fish and (2) increase in the price of diesel used for boats.

Therefore, after studying the problems, KSFC considered rescheduling of loans in respect of the defaults committed by purse-seiner operators, ice and cold storage Plants and boats. In respect of sick units, the additional terms loans were granted by way of Rehabilitation Assistance. The Corporation has so far sanctioned rehabilitation assistance to 20 purse-seiners cum trawlers amounting to Rs. 73.96 lakhs and of ice and cold storage plants involving rehabilitation assistance of Rs. 17.69 lakhs at concessional rate of interest.

Recommendations that emerged in Session II: Financial Needs

1. Gradual replacement of State and even autonomous financial institutions by commercial institutions as early as possible.

2. It was felt that in order to minimise the problem of recovery and outstanding dues, consessional interest rates by bankers in the early period of the loan or subsidy on the interest for a few initial years by the State Government may be helpful.

3. It was observed by the bankers that financing brackishwater farming was less risky. As such, the same may be encouraged by the State Fisheries Department.

4. Support price may be attemped in case of institutional marketing and fishermen may be asked to maintain their catch register.

5. The need for a techno-economic survey of the commercial bank financing of the industry evaluating the progress achieved so far, identifying the constraints, spelling out the procedures, check lists, etc. was suggested.

Socio-Economic condition of the Fishworkers of Karnataka

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ABSTRACT

Reading official reports of the transformation of fisheries in Karnataka, the progress is in terms of modernisation that has taken place in the past 25 years–trawling for shrimp since 1960, purse-seining for oil sardines and mackerel since 1975, and gill netting since 1978. In assessing what this progress has meant for the fish workers, the accent has to be on those who are actually physically involved in catching and marketing of fish, and their interaction and status vis-a-vis those who invest capital in these activities.

In 1960–61, when there were only 4 mechanised trawlers, the total fish catch was 1,00,591 tonnes. In 1970–71, when there were 1,041 mechanised trawlers, the catch was about 1,00,169 tonnes. In 1980–81, when there were 2,085 mechanised boats consisting of trawlers, purse-seines and gill netters, the total catch was about 1,15,232 tonnes. For this overall increase of about 20,000 tonnes over the 20 years of mechanisation, the investmentin mechanisation has been to the tune of Rs. 12 crores. It is clear that mechanisation has not added significantly to the fish catch in the State. However, this has resulted in uncalculated displacement of labour, lowered the quality of life and has introduced a category of "gentlemen" fishermen who have been able to secure government subsidies. The picture is complete when we see a number of fishermen gradually being pushed down, their whole consumption pattern changing from a comparatively prosperous life to a backward tragic existence. The mechanisation process has developed at such a pace that the workers seem to have been drowned in the wave. Those who have survived despite the odds have had time only to struggle to keep their heads above water. The massive financial inputs ploughed into the fisheries sector does not appear to have brought about any advancement of the socio-economic status of fish workers in Karnataka.

Although Karnataka only ranks fourth in the quantum of fish production in India, the rapid 'transformation' of fisheries in this State cannot be overlooked. Reading the official reports of the fisheries department, one cannot but be struck by the 'progress' in terms of modernization that has taken place in the past 25 years—trawl fishing for shrimp that was introduced in 1960 and then purse-seining for sardine and Mackeral since 1975 and gill netting in '78. One is also appreciative of the fact when the government reports that the traditional rampani workers (Units) were gradually modernised in such a manner that the conflict between the traditional and the modern sector was not taken to a climax. Karnataka can also boast of a 'successful' co-operative sector which has channellised loans and undertaken fish marketing. Karnataka has not been forced to liquidate its fisheries cooperatives as its neighbour Kerala has been forced to do. Looking at the total picture therefore, Karnataka which has an adjoining continental shelf of about 25,000 Sq. Km. with a fishing population of about 1,12,900 on a 300 Km. coastline, paints a brighter picture than its neighbouring States.

Fishworkers: Who are they?

It is necessary to go into the lives of the people who have been the main actors in this scene. As everywhere else there exists in Karnataka a traditional fishing community—from different religious and caste groupings-

Mongaveers, Daljees, Harikanth & Konkan Karves, gabits and ambigas.

But this community is very stratified. Not all who traditionally belong to the fishing communities can fall into the category of fishworkers—and then again, among fishworkers we have to incude women who depend equally on the profession for a livelihood and all the workers engaged on a wage basic in the transporting and processing sector.

In assessing the socio-economic status of the fishworkers therefore, the accent is on those who are actually involved physically in the catching, processing and marketing of fish and their interaction and status Vis-a-vis those who invest capital in the above activities. It is also important to assess this status in a dynamic manner, seeing what has happend to the fishworkers in the wake of the development activity that has gone on along the Karnataka coast during the past 25 years.

Some of the criteria may be to see whether the share of the fisherman in terms of the returns from fishing, has increased during this period of modernization, whether improved technology has lightened the physical effort of the operations, whether the cooperative movement has enhanced the participation of the fishworkers in planning, whether the returns from fishing have gone into raising the quality of life of the fishworkers or only into repaying loans, whether the women fishworkers have been able to stay in employment or have been thrown out of it.

Such an assessment would certainly require a detailed study which I have not undertaken. The material that follows has been taken from secondary data and observations made through visits to some areas of the Karnataka coast. Hence these are only broad generalizations indicating the trends rather than detailed facts of the changing status of the fishworkers of Karnataka.

Socio-Economic Conditions & Welfare Measures

Let us look at a few facts to start of with as published by the Ministry of Agriculture from New Delhi in 1983.

1. Coast line (Km)	280
2. Continental Shelf area (Sq. Km.)	25,473
3. No of fishing villages	147
4. No. of fish landing centres	105
5. No. of fishermen households	15,638
6. Fisherfolk population	
(a) Male	32,715
(b) Female	34,888
(c) Children	45,290
(d) Total	1,12,893
7. No of fishermen engaged in actual fishing	
(a) Full time	17,664
(b) Part time	5,558
(c) Occasional	1,783
(d) Total	25,005
8. Educational Status	
(a) Primary	21,596
(b) Secondary	5,174
(c) Above Secondary	1,553
(d) Total	28,323
9. No. of fishing craft	
(a) Mechanised	2,100
(b) Non-mechanised	6,942
(c) Total	9,042
10. No. of fishing gear	25,953
11. Average fish production in tonnes (1979–81)	1,68,264

12. Nature of welfare measures:
    (i) Subsidy/loan for purse-seine net, engine, gillnet unit and fishing requisites, creation of a distress relief fund and schemes for drinking water, electricity and allotment of sites and house.
    (ii) Different operational areas have been earmarked for different types of crafts; enactment of legislation is under consideration.

4.1. Assistance for diversification of mechanised fishing

Under this scheme, subsidy is given to purse-seine nets at 25% of the cost of the net subject to a maximum of Rs. 20,000 per net.

4.2. Mechanisation of fishing crafts

Subsidy is granted on marine diesel engine at 25% of the cost of the mechanised engine installed in fishing boats of the size of 30′ to 43′ length.

4.3. Assistance to 'Rampani' fishermen

Assistance to traditional 'Rampani' fishermen for opting to take over to mechanised purse seining in the form of a subsidy of Rs. 30,000/- on marine diesel engine, a subsidy of Rs. 30,000/- on purse seine net and a soft loan of Rs. 30,000/- through Fisheries Development Corporation. The beneficiaries will have to contribute Rs. 30,000/- and the remaining amount to be financed by the commercial banks.

4.4. Assistance to Gill Net Units

Under this scheme, subsidies are given to gill net units at 25% of the total cost of the boat, engine and nets limited to a maximum of Rs. 12,500/- per unit.

4.5. Assistance to traditional fishermen for procuring fishing gear

Through Fishermen Cooperative Societies, members are given loan-cum-subsidy for procurement of fishing requisites subject to a maximum limit of Rs. 750/- per individual and Rs. 1,500/- per group of two fishermen.

4.6. Distress Relief fund

For assisting fishermen in distress, a "Distress Relief Fund" has been created and the fund is operated by a Committee. The 'Ashakiran' Scheme, covering more than 39,000 fishermen, provides for payment of Rs. 2,000/- in the event of death or total disablement and Rs. 1,000 for partial disablement.

4.7. Landing and berthing facilities and approach roads

The Fisheries Department provides landing and berthing facilities and also construct approach roads in fishermen villages.

4.8. Drinking Water and Electricity

Drinking Water, electricity and allotment of sites, houses etc. are done by Revenue and Rural Development Departments.

4.9. Marine Fishing Regulation

The Government has demarcated operational areas in the sea for fishing crafts of different types to avoid conflicts between traditional fishermen and mechanised fleet. A belt from the sea shore up to 3 miles has been reserved for Rampani and traditional fishing operators. Night fishing by purse seiners has been banned.

Enactment of a separate legislation to regulate marine fishing operations is also under the active consideration of the State Government.

According to the government statistics, the involvement of the Government in fisheries is commendable. Enactment of legislation regarding demarcating of fishing zones for the mechanised and non-mechanised sector

and the ban of night fishing by purseiners has been done without a significant clash on the issue. Although there were sporadic confrontations between the 2 sectors in the initial stages, there was nothing similar to the struggles of the fishworkers of Tamil Nadu and Kerala on the same demand. But it we have to assess the impact this has had on the advancement of status we must look at the results more closely.

What has all the input in modernization meant in terms of increase in catch of fish: a ratio of 3 active fishermen to a craft (be it mechanised or non mechanised). In 1960–61 when there were only 4 mechanised boats in the State (trawleis) the total fish catch was approximately 1,00,591 tons. In 1970–71 when there were 1041 mechanised boats (trawlers) the total fish catch was approximately 1,16,936 tons. In 1980–81 when there were 2085 mechanised boats (trawlers, gill-netters and purse-seine) the total fish catch was approximately 1,15,322 tons (an average of 1,19,635 tons during the years 75–81). An overall increase by about 20,000 tons over the 20 years of mechanization—a significant portion of the catch still coming from the traditional sector wherever they operate. The approximate investment in mechanization on the other hand has been to the tune of (Rs. 12,00,50,000) to be on the lower side.

What has this probably meant to the fishworkers. It is a fact that the government has made an effort to see that the owners of the Rampani units were gradually able to acquire a mechanised boat—on the purse-seiners the proportion being one purse-seine to 30 share holders. But a rampani, which beside its owners required the hired labour of 50–100 workers have not been considered. They have probably been absorbed in the loading-unloading activities of the mechanised boats. Here again there are difficulties. Landing centres are not as dispersed—which means that workers have had to go long distance from their usual areas of living.

Then again, loading and unloading has, in many areas, been the share of the women fish workers who have been displaced from marketing. In Tadri for instance, such women over 300 in number, have come to an agreement as to the division of the task of unloading of fish—for a wage. As no comprehensive statistics exist of this section of the labour force, they remain an unidentified marginalised sector, living at a mere subsistance level. A detailed study made by John Devaraj in 1980 in a rampani operated area of Kulai village in Dakshina Kannada is very revealing. It states that before the introduction of the purse seiners, the rampani had two catches per day, the average catch value per annum varying between Rs. 3-4 lakhs per unit. These operations naturally generated tremendous employment up to 1976. But after, with 50 purse seines operating out in Kulai coast, the rampon padavus (boat) gradually became inoperative. What has this meant qualitatively.

1. Food consumption reduced from 3 full meals a day to 1 meal.
2. Consumption of tea 11+15 cups to a single cup. Most of the shops closed.
3. All gold and other valuable articles pawned in banks for loan. Much of it sold.
4. Many marriage proposals have been blocked, due to economic difficulties.
5. There is no money to repair, re-roof or maintain the houses. As a consequence in the rainy seasons of the Malnad, terrible sufferings are to be endured.
6. The relief loans given by the goveinment cannot be repaid. The government officials threaten to take them to jail, impose punishment.

7. The Mahajan Sabha was helping the traditional fishermen from its funds (collected from fishermen), now the fund has gone bankrupt. Help during rainy seasons, marriages, deaths, festivals, emergency loans etc. were all at a standstill.

8. No money for entertainment. There is no money to purchase a ticket, how is it possible to move anywhere? Social mobility has come to a grinding halt.

9. Excessive burden on women who have to find all kinds of small jobs to keep the Kitchen fire burning at home.

If there is no fishing then what has happened to the 2500 fishermen of Kulai.

700 of the young and strong fishermen have transposed themselves into the mechanised sector-500 on the purse-seiner and 200 on the trawlers. The majority of the remaining 1800 are idle.

Over a 1000 of these traditional fishermen are over 40 years, 500 of them between 35 and 40 years. Mechanised fishing is only for the young. Only the youth can rough it out in the landing centres. The middle aged and the old have no place. In a rampani unit a fishermen would have worked till he could hold the hemp at the Rampon net, till the sea calls him back for ever. What is the choice now?

So while mechanization has not added significantly to the catch, it has resulted in uncalculated displacement of labour, lowered the quality of life and has introduced a category of 'gentleman fishermen', perhaps from the fishing community (teachers, bank employees etc.) who have been able to secure the government subsidies for the purchase of mechanised boats.

There is no data either to assess the indebtedness of the fishworkers. While both the department of fisheries and the banks say that loan repayment has been distressing over the last 5 years, one would ask whether borrowers are wilfully not repaying. In north Kanara for instance again in the Tadri area where all marketing is done through the fish marketing cooperative, the same problem is faced. While catch has not increased substantially the value has increased but yet investment and depreciation costs are hard to recover. Moreover one cannot observe an abvious spending in non productive expenditure—no striking concrete housing, no large dowries for marriage but definitely, a consciousness for higher education as the only means to escape the unrewarding future in fisheries. Again from a study made by John Devaraj of Sashithlu Village 30 Km. from Mangalore he states that a drastic cut in food consumption is noticed as also in clothes with a simultaneous increase in payment for education and cost of net repairs.

The picture is complete when we see number of fishermen gradually being pushed down, their whole consumption pattern changing from a comparatively prosperous life to a backward tragic existence.

No similar case studies exist in the North Kanara area where population is less dense, and the inland waters offer also a possibility of livelihood. The visual impression may not be as depressing as the examples above.

Discussing with the President of the Tadri Fishermen Cooperative which started in 1951 and is a successful cooperative, one gets an idea of the hopes and despairs of local initiative: It has 921 members and pays a 6% profit bonus to about 150 members—because bonus is paid only on the basis of a participation of fish sales. The Cooperative was initiated with the hope of seeing that fisher-

men get a good share of the development investments. The majority of its members on the contrary get the advantage only of the spill off effects—the consumer store, consumption loans etc. It owns 4 purse-seine, which have been run on a group basis—30 fishworkers to a pursesein otherwise marketing the fish of individually owned (gentleman fishermen) purse seiners. How does Mr. Moodangi, who has been the full time president from the start of the cooperative see the evolution of the fishworker and future. The 31 years have only been an up hill climb. Starting off with the distribution of nylon yarn, rations and loans for constructing traditional canoes, they were able to distribute a few trawl boats with a subsidy. They couldn't get any benefit from the Rampani scheme but in 75–76, to off-set the dominant effects of the purse-seiners operating in Goa and Mangalore, they were forced to go in for the construction of 4 puse seiners and then loans for a few gill-nets. But all the same he admits that the catch is decreasing and the purse seines are unable to go deeper into the sea because of formidable costs. Hence he feels the future lies in 'Deep sea' 'industrial fishing' to catch the limitless shoals 'out there'. He neverthless adds that an oceanographic survey should first be undertaken under the IDFP to assess the resources.

The experienced dedicated worker, has been once bitten. He is not as optimistic as all the government plans and proposals make out to be.

Speaking to officials of the department of fisheries in Karnataka, they are aware of the negative consequence of the rapid & uncontrolled increase in the purse seine fleet and the fact that this, while affecting the regeneration of the resource has negatively affected the fishworkers as a whole. The mechanization process has developed at such a pace that the workers seem to have been drowned in the wave. Those who have survived despite the odds have had only the time to struggle to keep their heads above water with the result that there has evolved neither any significant workers' movement in the area or creative ventures that indicate a spill over of excess income or consciousness gained in the process. One cannot easily conclude therefore that a qualitative advancement of the Socio-economic status of the fishworkers of Karnataka has taken place over the decade when massive financial imputs have been ploughed into the sector.

Labour Conditions in Fish Processing Industries along Dakshina Kannada Coast

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ABSTRACT

Eighty labourers of 17 fish based industries in Dakshina Kannada were personally interviewed during 1983–84 fishing season to study the labour conditions in processing industries based on socio-economic factors. On an average, male labourers enter into service in a processing industry at the age of 19 to 25 years and female labourers start working at the age of 16 to 22 years. Most of the labourers were young, in the 20-30 years age group. comprising 63.5% of the total workers interviewed. When workers were classified as skilled and unskilled labourers, 93.3% of the skilled workers and 59.3% of the unskilled workers were found to be engaged in 1 or 2 subsidairy occupations. The average seasonal total incomes of unskilled and skilled wo kers were estimated at Rs. 7830.00 and Rs. 8993.00 respectively and there was no significant difference between the mean total income of 2 classes of labourers. But the earning capacity of unskilled labourers was more compared to skilled labourers. An attempt was also made to assess the average expenditure. savings and assets of labour families in this study. It is pointed out that minimum wage policy through legislation and other possible benefits should be extended to the labourers of fish processing industries.

Fishing, which is a seasonal industry, provides employment only for a period of about six to nine months in a year, with brisk and slack days in between. This necessarily forces those involved in fishing to adpot more than one occupation for their livelihood. Similar is the case with those employed in fish processing industries, the running of which depends on the availability of raw material. The seasonality of raw material availability puts the concerned labourers out of employment during the slack season. Longer the slack season, the more pitiable is the economic condition of the workers concerned and less the earning of foreign exchange through export of marine products. Krishna Iyer *et al.* (1981)** had conducted a survey on the idle capacity of processing plants all along the west coast of India. However, no report is available on the working and economic conditions of the workers in fish processing industries either on the east or the west coast. Therefore, the present investigation was undertaken to study the working conditions and socio-economic aspects of the labour force employed in fish processing industries in Dakshina Kannada district on a sample survey basis during the 1983–84 fishing season.

Material and Methods

There were 4 fish meal and oil plants, 31 ice and cold storage plants, 4 fish canning factories and 14 fish freezing plants functioning actively along the Dakshina Kannada coast under private sector during the period under study. To study the labour conditions in these factories, a sample survey was conducted based on 3 fish meal and oil plants, 7

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ice and cold storage plants, 2 canning factories and 5 fish freezing plants selected at random. In all, 80 workers were personally interviewed to elucidate their working and socio-economic conditions. Information on sex composition, marital status, education, experience, family size, sources of income, expenditure and assets were the main parameters sought. The labourers were classified into skilled and unskilled workers. The former category included technicians, retorters, mechanics, boiler attenders, electricians, chemists, welders, fitters, supervisors, drivers, etc., while the latter consisted of general workers, like ice lifters, packers, watchmen, etc., Of the 80 workers interviewed, 19 were skilled and the remaining 61 unskilled. The data collected by means of schedules were analysed suitably to throw light on the labour conditions in fishbased industries.

Results and Discussion

Age distribution

Table 1 gives the age distribution of workers sex-wise in various types of fish processing industries. As can be seen from the table, child labour was absent and women labour was only to the extent of 21.25%. Most of the labourers were young between the ages of 20 and 30 years, and this group comprised 63.5% of the total workers interviewed. Further, the analysis has shown that the mean age of male worker was 29 years, whereas it was 26.4 years in case of females. This preference of the industry for young workers must be due to the arduous nature of the work, particularly during the peak season. It may also be due to the reluctance of older persons to work in this exacting industry. Only 22.5% of the labourers were in the middle age group of 30-44 years and 8.75% in the age group of 45-60 years. The sex ratio of workers in the various fish processing industries surveyed was never found to be 1:1.

Table 1. Age distribution of male and female workers

Age in years	Number of	
	Males	Females
15–20	3	2
20–24	17	9
25–29	23	1
30–34	8	3
35–39	6	0
40–44	0	1
45–49	2	0
50–54	3	1
55–59	1	0
Total	63	17
Average	29 years	26.4 years

Experience

Table 2 gives the details of length of experience of male and female labourers in the area of fish processing. Most of the labourers had experience ranging from 4 to 10 years, which amounts to 60.3% in the case of males and 70.6% in the case of females. When this is viewed against the age structure of the labour force, it would appear that the male labourers had entered

Table 2. Working experience of labourers

Experience (in years)	Males	Females	Total
No experience	3	1	4
1	5	2	7
2	4	—	2
3	8	—	8
4	10	2	12
5	5	5	10
6–7	13	1	14
8–10	10	4	14
More than 10	5	2	7
Total	63	17	80

the industry in the age of 19 to 25 years and the females at the age of 16 to 22 years. In other words, females appeared to startworking earlier in life than the males. Only 8.75% of the labourers were found to be having more than 10 years experience. This indicates that most of the labourers drift out to other more gainful employment rather than stick on to fish processing only.

Subsidiary occupations

Information was gathered on the number of other subsidiary occupations pursued by the labourers in fish processing industries and the same is delineated in Table 3. Out of 80 labourers interviewed, only 11 labourers (13.75%) were not engaged in any other type of work, while 46 labourers (57.5%) were having 1 or 2 other subsidiary occupations. The remaining 23 labourers (28.75%) were having 3-5 subsidiary occupations. It can also be made out from Table 3 that unskilled labourers go more for subsidiary occupations than the skilled workers. During the course of the survey it was observed that many of the skilled workers were doing part-time jobs elsewhere or at home based on their experiise only. On the other hand, the unskilled workers were found to go for other types of occupations and some were seen to be depending on financial assistance from their children or relatives working elsewhere. This aspect has its effect on the total income of the labourers, which is dealt with separately elsewhere in this paper. Lack of literacy was found to be the main restraining factor for many of these workers from choosing other more gainful occupations.

Table 3. Number of subsidiary occupations of fish processing labourers in the sample

Number of subsidiary occupations	Number of labourers	
	Skilled	Unskilled
1	10	18
2	4	14
3	—	20
4	1	1
5	—	1
Total	15	54

Education

Table 4 gives the educational standard of male and female labourers. Only 5% of the total number of labourers interviewed were illiterate, while 61.25% had studied upto middle school. Only 23.75% had attended higher secondary school, but could not complete their matriculation. Only 10% of the labourers had completed their matriculation examination. Perhaps this low level of education came in the way of these workers getting any other type of employment. The overall ltteracy was found to be higher among males than females. This must be mainly because of poverty, which would have forced the younger females to earn especially by means of beedi rolling, which requiies no education or skill. This type of extra income is earned mostly by unmarried woman folk during theii off time at home.

Table 4. Literacy of fish processing workers

Literacy	Number of	
	Males	Females
Illiterates	3	1
Primary School (less than 4th Std.)	11	5
Middle School (5th to 7th Std.)	26	7
Higher Secondary (8th to 10th Std.)	15	4
Matriculation passed	3	—
Pre-University	5	—
Total	63	17

Marital status

Table 5 shows that 61.25% of the workers interviewed were unmarried, while 35% of them were married and 3.75% were divorced, There was, therefore, a clear dominance of the industry by the younger unmarried age group. 76.47% of women workers were unmarried, as against only 57.14% among male workers. It was observed during the course of the survey that female unskilled workers were mostly employed in processing industries to clean, peel, dress, grade and pack the prawns and fishes. The analysis has revealed that about 70% of the labourers were working in these types of industries, while the remaining were engaged in canning or fish meal industries.

Income distribution

The study of income distribution of fish processing labourers was one of the main but difficult aspects of the present survey. This parameter indirectly reveals their living conditions. During the course of the investigation, it was found that there was no set pattern of wages for labourers in any processing industry sampled. The income of labourers was studied under 'salary' alone and under 'total income' (including salary) both for skilled and unskilled workers. In the present context, 'salary' includes money earned from over time work (about Rs. 500–700 per season) and bonus (8.33—20% of basic salary), while 'total income' includes income earned through subsidiary occupation and/or money received regularly from relatives, besides the salary in the fish processing industry. These are shown in Table 6 and Table 7 respectively. Table 8 gives the results of analysis of these two tables. As

Table 5. Marital status of workers in fish processing industries

Marital status	Number of				Total
	Males		Females		
	Skilled	Unskilled	Skilled	Unskilled	
Married	9	18	—	1	28
Unmarried	10	26	—	13	49
Divorced	—	—	—	3	3
Total	19	44	—	17	80

Table 6. Frequency distribution of salary of skilled workers and unskilled workers

Unskilled workers		Skilled workers	
Salary range (Rs.)	Number of workers	Salary range (Rs.)	Number of workers
1001–1500	2	3001–4000	3
1501–2000	11	4001–5000	5
2001–2500	10	5001–6000	5
2501–3000	3	6001–7000	3
3001–3500	14	7001–8000	1
3501–4000	11	8001–9000	1
4001–4500	5	More than 9000	1
4501–5000	2		
5001–5500	2		
5501–6000	1		
Total	61	Total	19

Table 7. Frequency distribution of total income of workers

Total income range (Rs.)	Number of unskilled workers	Number of skilled workers
2001–4000	14	1
4001–6000	14	0
6001–8000	9	8
8001–10000	7	6
10001–12000	4	2
12001–14000	5	0
14001–16000	6	0
16001–18000	1	1
18001–20000	1	1
Total	61	19

Table 8. Statistical analysis of mean total income and mean salary of skilled and unskilled workers

	Unskilled (2399.60)	Skilled (5548.80)	Percentage increase	t-value
Salary	3020.98 (±1098.99) (36.37)	5558.39 (±1703.74) (30.65)	83.99	7.515*
Tota income	7830.57 (±4364.19) (55.73)	8993.05 (±3870.14) (43.03)	14.85	1.078
Percentage increase	159.20	61.79		

(±)=standard deviation
( )=coefficient of variation
* =significant at 5% level.

could be expected, there was wide difference in the salary of skilled and unskilled labourers as well as in their total income. The percentage increase of mean salary of skilled workers over unskilled workers was 84%, whereas, it was only about 15% when total income of two groups was considered. On the other hand, the percentage increase of total income over and above salary alone was 159% in the case of unskilled workers, while it was 62% in the case of skilled workers. This gives a clear indication that labourers do not depend mainly on the employment in processing industries for money and that unskilled labourers earn better income elsewhere than skilled labourers to the extent of 97% more. Such earning was mainly from sources like beedi rolling, manual labour, agriculture and through receipt of money from relatives. In the case of ice plants, the workers get commission also. This shows that the earning capacity of unskilled labourers is high compared to that of skilled labourers. Though for outward look these labourers were below the poverty line, it was observed that the living conditions were not so bad. The percentage difference in mean salary and mean total income of labourers was about 69%. To get some more ideas about income, the data was analysed statistically by 't-test' to see whether there was any significant difference in the mean salary and mean total income between unskilled and skilled labourers separately. It was found that there was no significant difference in the mean total income, whereas, the mean salaries were significantly different between two groups at 5% level. It requires no statistical technique to infer that there existed significant difference between mean salary and mean total income for two groups of labourers

The wages of labourers varied according to the type of industry, type of job and the experience of the workers. When the wages were further analysed, it was found that the minimum monthly wage was Rs. 150/- (in an ice plant) and the maximum Rs. 330/ in a fish meal and oil plant). In addition to this, there was single over time allowance and double over time allowance in some of the processing industries. This amounts to Rs. 100/- to Rs. 500/- in a season. This facility was not available to ice plant workers, but they do get a commission of Re. 0.50 for crushing one block of ice, thus earning about Rs. 500/- to Rs. 700/ per season. In addition to this, all unskilled workers enjoy the benefit of bonus of 8.33%, 16.66% or 20% of their total salary, depending on the norms of the concerned factory. The monthly wage figures give the idea that labourers were relatively underpaid when compared to other product oriented type of industries.

Expenses

An attempt was made in the present survey to estimate the total expenses of a labour class family. This was found to depend upon many factors, like type of family, number of family members, sources of income, food habits and so on. However, this aspect of the

study was helpful in understanding their standard of living. After analysing the total expenses of the 80 families, it was estimated that Rs. 6,541.37 and Rs. 4,874.95 were the mean expenditure per year respectively per family of skilled and unskilled labourers. The total expenses were calculated based on all important items, like food, clothing, fuel, education of children, conveyance to working place, medicines, etc. The figure arrived at here may not be quite accurate, since it was difficult for the labourers to keep an account of their actual expenses due to their illiteracy and also because they tended to boost up their expenditure figures.

Savings

From the previous discussion it follows that there was good saving among labourers to the extent of Rs. 2,500/- to Rs. 3,000/ per year. The survey revealed that about 26.25% of the workers save in the form of provident fund (8% of salary), 12.5% in the form of life insurance policies and about 15% in the form of deposits in banks or post office. Out of the total sampled labourers, 62.5% were found to save in one form or other. The saving habit was more prevalent among skilled workers (78.9%) than among unskilled workers (57.38%).

Assets

Another important factor is the value of assets built-up in the form of gold, furniture, steel utensils and immoveable properties like house, fields, livestock, etc. Separate estimates were made of these for skilled and unskilled workers and the same are delineated in Table 9. One striking feature which can be noted from this table is that most of the families were well settled and only about 50% of unskilled labourer families were owning assets worth less than Rs. 15,000/-, while it was only 42% in respect of skilled labour families. About 35% of the labourers were found to own assets worth more than Rs. 24,000/-. In most cases, these assets were built up by their ancestors. Therefore, it would appear that these assets have no direct relation to the present income of the workers. On the other hand, about 54% of unskilled labourers and 47% of the skilled labourers had debts, mainly from their employers. This indebtedness has given the employers a strong hold on the labourers. The loans are taken mainly for unproductive purposes, like house building, repairs to house, religious functions, etc. with the amount of loan ranging from Rs. 500/- to Rs. 5,000/-. From this it is obvious that many of the labourers need higher wages than the existing ones in many of the processing industries.

Table 9. Value of assets of processing workers

Range (in Rs.)	Unskilled workers	Range (in Rs.)	Skilled workers
Less than 3000	4	Less than 5000	3
3000–6000	11	5000–10000	4
6000–9000	7	10000–15000	1
9000–12000	6	15000–20000	1
12000–15000	3	20000–250000	2
15000–18000	2	More than 25000	8
18000–21000	4		
21000–24000	4		
24000–27000	6		
27000–30000	4		
More than 30000	10		
Total	61	Total	19

Other benefits

It was found that many of the processing industries were extending medical facilities to their employers through the E.S.I. Many of them were also found to supply 2 pairs of uniform every year, in addition to other usual benefits essential for such type of labourers. Over time facilities do exist in most of the processing industries. Some of the ice plant owners give Rs. 100/- as a token of incentive

to their employees. Free food and tea were also being served to labourers whenever there was lot of work in the processing industries. Labourers enjoy government holidays and also casual leave as per rules. Casual leave benefits are encashable for labourers in some of the processing industries.

Conclusion

From this present survey on labour conditions in fish processing industries of Dakshina Kannada coast, it may be stated that even regular employees enjoying the benefits of provident fund, over time allowance, casual leave, etc. have only seasonal work in this industry. During the off season they have to go in search of alternate avenues of earning for their livelihood. On the whole, the labourers are relatively underpaid and there is need to fix a minimum wage through legislation and give them security of employment round the year, irrespective of work in the processing industries. There should be some provision to raise the wages of employees year after year in keeping with the cost of living index. Medical benefits are not extended by all the factories at present. This should be made compulsory through legislation. Some categories of workers are not as yet trained in their respective jobs and hence it is necessary for the employers to get them trained. Payment of minimum statutory bonus of 20% may be made compulsory through legislation for all type of fishing industries. If the above recommendations are extended to the employees of fish processing industries, it will go a long way in making these jobs more attractive and secure, which in turn would help boosting the industrial output in this sector.

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Structure and Functions of Successful Fisheries Cooperatives

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ABSTRACT

Marine fishermen co-operative system in India has not been able to develop a viable volume of business because of vested interests, poor management and rising overdues. Sincerity of leadership and loyalty of members are now essential for the success of the fishermen co-operative movement.

Of 121 fisheries co-operatives in Karnataka, 61.2% were running on profit as against an all India average of 27.1%. In the absence of a uniform Karnataka State Fisheries Act and consequent State Financial Assistance Rules, financial assistance to the fisheries co-operatives is governed by different schemes for limited periods. This does not encourage long-term investment policy. Linking of credit with marketing, conversion of certain financial assistance into redeemable share capital, measures to shift financial dependence of the fisheries co-operatives from the government to commercial institutions, and continuous evaluation of performance are some of the measures that need to be adopted.

1. Concept of success: The concept of success is a very relative term which can be illustrated by the example of two examinees. One coming out of the examination hall is very happy because no examiner can award him less than 40% marks and he is sure to succeed whereas the other is sorry because he has unnecessarily lost 5 marks and may get only 95% marks. It is, therefore, essential to define precisely the concept of ' Successful fisheries cooperatives".

In this connection, if we take physical targets into consideration i.e. the percentage of fish caught, fishery inputs supplied, fish preserved, processed, marketed, exported etc. by fishermen cooperatives, we shall be highly disappointed. Unfortunately, very little attention seems to have been paid to the analysis of these percentages while planning for fisheries cooperatives. For example, fishermen cooperatives in Maharashtra State are said to market about 28% of the total catch in the State but it constitutes as much as 50% of the total Indian catch marketing through cooperatives. Though India is a leading shrimp exporter, share of fishermen cooperatives in the same can be safely termed as negligible whereas in Hongkong the same is.....However, according to N.C.A. (1976), the number of marine fishermen cooperatives has increased to 2799 with 27.1% showing profit but the cooperative system had not been able to develop viable volume of business because of the vested interests of influential members, rising overdues, poor management etc. The total membership of marine fishermen cooperative societies during 1972–73 to 1976–77 has either declined or remained constant. In most states, the reserve funds and government paid up capital put together formed more than 50% of their total funds and overdue loans ranged between 32% and 86% except Maharashtra where it was only 12% in 1976–77.

The adoption of N.C.D.C. pattern of

financial assistance through Special Redeemable Share Capital (S.R.S.C.) and conversion of sponsored groups of fishermen into co-operative societies subject to a set of rigid conditions like penal rate of interest, V.R.C. as a pre-requisite for the disbursement of loans direct payment to engine and winch suppliers, compulsory insurance of boats etc. have encouraged cooperative movement very well in Maharashtra State resulting in the formation of 694 societies with a membership of 96,482, catching and selling fish worth Rs. 814 and Rs. 1,298 lacs respectively in 1980–81.

On the other hand, the fishery cooperative movement has virtually collapsed in Kerala State as pointed out by the Report of the Resuscitative Committee for fisheries co-operatives, 1976 (Government of Kerala) and also by the Report on the Strategy and Action Programme for a Massive Thrust in Fisheries Development and Fishermen Welfare in Kerala State, 1980–83. The latter stated that "Only a handful of societies are having offices of their own....The majority of societies are found to be not in the habit of convening general body meetings....The societies have even failed to arrange for the conduct of election, with the result that over 60% of them are having invalid boards.... The audit of accounts of most of the societies are heavily in arrears"—(p. 89). According to the former (Resuscitative Committee for fishery cooperatives, 1976 (p. 31), the chief reasons for the failure of fishermen credit societies were lack of a suitable agency to meet their working capital, linking of credit with marketing and sincerity on the part of borrowers to repay the loan and above all action by the concerned authorities for repayment of loan. In the midst of even such a dismal failure in the State (Kerala), the Matsya Utpadaka Cooperative Society Ltd., Marainad (No. F.T. 287) made phenomenal progress during the period 1967–68 to 1975–76, as can be seen from the table 1.

It is, therefore, obvious that it is not merely a question of the structure, constitution, functions and even socio-legal set-up for the success of fishermen cooperative movement

Table 1. Showing progress of Marianad Fishermen Co-operative Society during the period 1967–68 to 1975–76

Year	Share capital (Rs.)	Fish Sales (Rs.)	Fish supplies sales (Rs.)	Foodgrains sales (Rs.)	Savings of members (Rs.)	Retains** (Rs.)	Bonus & Dividend (Rs.)
1967–68	600	—	—	—	—	45(Loss)	—
1968–69	600	—	—	—	—	79(Loss)	—
1969–70*	920	50,000	—	—	1,000	423	—
1970–71	2,130	74,000	4,200	—	1,480	1,850	—
1971–72	2,165	1,46,000	12,300	—	2,920	1,412	—
1972–73	2,170	1,13,000	11,200	—	2,260	1,443	Div. 8% Participation bonus Rs. 2 for every Rs. 1000 worth of fish sold through co-operatives
1973–74	2,795	1,40,000	19,900	—	2,800	1,563(Loss)	—
1974–75	3,715	3,40,000	28,000	—	6,800	5,743	Div. 10%
1975–76	3,820	6,65,000	45,000	1,40,000	9,200	4,990	Bonus Rs. 0.25 per Kg. of fish

*Cooperative taken over by real fishermen.
**Excess of income over expense.

Source: Marianad M.U.C.S. Ltd., F(T) 287 Annual Report, 1975–76.

but of the sincerity of leadership and loyalty of members also.

So far as the State of Karnataka is concerned, the over-all performance of fishermen cooperative movement can be termed as better than average, specially in view of the absence of uniform State Fisheries Act for the state as a whole and of State Financial Assistance Rules under the same, as can be seen from the following table:

It is observed that out of a total of 121 societies, 61.2% were running on profit against an All India average of only 27.1%. It shall be further observed from the table on the subsequent page that the number of primary societies has declined since then and stabilised at about 70. The origin of fisherwomen cooperative societies in South Kanara district is a unique land-mark which seems to have met a good response. Similarly, the Pygmy Savings Scheme has shown good response. Under it, the Malpe Society collected Rs. 60,000/- during its first year (1980–81) itself and utilised the same for the purchase of transport can and also availed a subsidy of Rs. 45,000/- from D.R.D.S. However, the S.K. District Federation was in difficulties and had to repay Rs. 32.27 lacs,

Table 2. Performance of Primary Fishery Cooperative Societies in the maritime states (1976)

State	Number of primary fishery societies	Societies Showing profit	Societies showing loss	Societies with no-profit no-loss	percentage of societies showing profit
A.P.	527	114	363	120	19.1
Gujarat	59*	25*	27*	7*	42.4*
	(168)	(70)	(56)	(42)	(41.7)
Kerala	985	130	780	75	13.2
Maharashtra	381	181	156	44	47.5
Karnataka	121	74	30	17	61.2
Orissa	154	48	63	43	31.2
Tamil Nadu	488	169	270	9	37.7
Goa, Daman & Diu	11	4	7	—	36.2
Lakshadweep	3	3	—	—	100.0
Total	2,799	748	1,696	315	27.1

Source: National Commission on Agriculture, 1976., Part VIII, p. 160.
Gujarat figures in brackets relate to 1979–80.

Table 3. Showing number and types of fishermen cooperative societies in Karnataka State

Year	Number of fishery cooperative societies			Number of fisherwomen co-operative societies			Number of district co-operative federation			Grand total		
	N.K.	S.K.	Total	N.K.	S.K.	Total	N.K.	S.K.	Total	N.K.	S.K.	Total
1979–80	34	31	65	1	—	1	1	1	2	36	32	68
1980–81	34	31	65	2	—	2	1	1	2	37	32	69
1981–82	34	31	65	4	—	4	1	1	2	39	32	71

S.K.=South Kanara district. N.K.=North Kanara district.

Rs. 2.09 lacs and Rs. 20.08 lacs to N.B.-A.R.D.,N.C.D.C. and the district cooperative bank on 31–3–1982.

2. Structure: The 3-tier (.e. primary, secondary/district and state level) structure has by and large stood the test of the time since the inception of cooperative movement in India and abroad. There is hardly any need for a meaningful debate on the issue specially in view of the cooperative nature of the marine fishing operations, isolated and rural based character of the industry, small markable surplus, consequent need of pooling the catch, highly perishable character etc.

3. Functions: So far as the scope of functions is concerned, a multi-purpose and integrated approach, inter-linking not only credits, supply of fiishery inputs, preservation, processing, marketing, production, consumption needs, social, housing, literary welfare etc. i.e., a package programme is likely to be self-generating and more beneficial for the development of fishermen cooperative movement.

4. Basic requirements: As is evident from the exceptional success of the Marianad Cooperative Society under the same Constitutional structure, social and legal set-up, as discussed earlier, the basic needs for the development of fishermen cooperative movement are the loyalty of members and devoted leadership.

(i) Loyalty of membership: Without any fault of fishermen in view of their poor economic, social and literary conditions, the loyalty of members is one of the most important requisite for the development of a successful fishermen/fisherwomen cooperative movement. In a large number of cases, the member fishermen is already indebted to a money-lender who in a large number of cases is a fish-merchant as well. Further, he is more easily accessible than the cooperative society. It, therefore, adversely affects his loyalty for which we can hold our social order more responsible than the poor and socially backward fishermen.

(ii) Leadership: The leadership in fihermen cooperative societies often consists of vested interest. In a large number of cases, it consists of fishermen themselves who are either literate or/and politically motivated. During a survey regarding the recovery of I.R.D.P. loans in Andhra Pradesh in 1983, it was observed that fishermen were reluctant to deal with the commercial banks through their respective cooperatives and preferred to deal directly to ensure proper accounting of the repayments. Perhaps, the basis prescribed qualification of 150 fishing days or so in a year or a substantial (i.e. about 80% or above) income from fishing may help in minimising the vested leadership.

Another area for improving the leadership may be with the help of adjusting balance of power between the non official and official representation in the control of cooperative societies. Both types of representation have their own merits and demerits. At a time when social work has become more a profession than a matter of self-sacrifice, it is essential to reconsider this issue because there is atleast a code of conduct for bureaucrats but nothing for non-official workers.

5. Management Measures: They can be categorised as follows:

(i) Channelisation of financial assistance through cooperatives: As we all know, fisheries development is still largely a state financed programme in a large number of cases. The state financial assistance should be channelised through cooperatives as far as possible, as is done in Karnataka State also under the scheme for improvement of

Traditional Fishing—Supply of O.B. Engines under the Government Order No. S.W.L.-466 SFS 74, Bangalore dated 23/25th Dec., 1975 and a few other schemes.

However, in the absence of uniform Karnataka State Fisheries Act and consequent State Financial Assistance Rules, the financial assistance is governed by different State Schemes introduced under different government orders for a limited period of 3 to 5 years. Therefore, it does not encourage a long term investment policy. Moreover, there is hardly any research and evaluation work which forms the basis of these schemes. It is, therefore, essential that Karnataka State Fisheries Act and Karnataka State Financial Assistance Rules with adequate provisions for the encouragement of fishermen cooperative societies should be enacted at a very early date.

(ii) Integrated Approach: The system of linking credit with marketing should be enlarged so as to cover the supply of fishery inputs, preservation, processing, pooling of catch and even housing, literary and other welfare activities as per package approach. The Kerala Fishermen Welfare Societies Act, 1980 is a very encouraging step in this directions and should be adopted in other states also.

(iii) Adoption of Special Redeemable Share Capital (S.R.S.C.) System: Under this, system the financial assistance, which is advanced subject to prescribed conditions, is converted into redeemable share capital. It entitles the government to an equivalent amount of shares in the society. It is also helpful in more effective state supervision of the societies and also reducing the vested interests. It is, therefore, suggested that this system (which has been successfully adopted in Maharashtra State) should be introduced in other states also.

(iv) Shift from state financial support to autonomous and commercial institutions: Every possible effort should be made to allow the cooperative societies to stand on their own as far as possible. Efforts should also be be made to shift dependence from direct state to government sponsored schemes like I.R.D.P., to autonomous (N.C.D.C.) and then to commercial institutions. The state fisheries departments should try to restrict their role to policy-making, research, supervision, advisory, training activities etc. as far as possible and as soon as possible.

(v) Annual / quinqueneam evaluation: In order to ensure an effective and prompt monitoring to identify the obstacles as well as achievements, it is essential that each scheme/project should be evaluated annually and quinquineally professionally like, F.F.D.A. by National Council of Applied Economic Research, Delhi and mechanisation of marine fishing by Programme Evaluation Organisation of Planning Commission. The observations of these evluations shall not only be helpful in the feed-back and monitoring but serving as guide-lines for future planning.

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Structural Parameters of Successful Fisheries Co-operatives

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ABSTRACT

Fisheries is quite different from the agricultural sector. Fisherfolk in general and traditional fisherfolk in particular have been severely marginalised historically. One stream of development work aimed at the development of fisherfolk was through the formation of co-operatives. In places where balanced participation was not ensured, these attempts have failed. Marianad Model was one model of formation of Fishermen Co-operative. The model assumed democratic structure and economic participation, and utilized economies of scale and advantages of collective bargaining.

A fishermen co-operative may be called successful only when it is separately an economically viable unit and able to function as a coherent group able to sort out differences internally. To evaluate the performance of a co-operative certain factors serve as indicators. They are financial performance, participation, social benefits and individual benefit obtained. These factors are individually necessary and collectively sufficient for the success of a co-operative. The case-study illustrates the dynamics of a successful co-operative.

The factors that ensure the success of a co-operative have been identified as internal leadership, membership quality, basis of organisation of activities, environmental factors and governmental policies. All these factors are dynamic and the co-operative has to be responsive to changes in them, Apex bodies, which are a result of an extension of the basic philosophy, can help primary co-operatives in tackling problems which they may not be able to solve alone.

1. Introduction

The pecularities of the marine fisheries sector in contrast with agriculture stems from two factors. Firstly, while agriculture involves the activities of planting, tending and finally harvesting of a crop, in fisheries, it is only a perpectual harvesting operation akin to a hunting operation. Secondly, they yield of a harvest in fisheries unlike agriculture is extremely variable and dependent on factors such as the specific craft gear combination used, the level of skill and the varying distribution of fish which changes from season to season. Whereas agriculture in our country has always been a main-line activity, fisheries sector and fisherfolk has always remained at the periphery. Even today, it occupies the status of only one of the allied activities' to agriculture. In con sequence, the sector in general and the traditional sub sector within it in particular, still remains backward in assimilating most of the social, economic and technological changes taking place around them. This social marginalisation is quite drastic in contrast with the increasing shase of marine exports in the national income and fish as an important source of protein for domestic consumption

In the last few decades, there has been several attempts to remove this anachronism

and to integrate the fisherfolk into the mainstream of the nation. These attempts have been sponsored both by the Government and by Non-governmental organisations. In many cases, the focus has been introduction of new varieties of fishing gear and/or craft for instance the Government sponsored introduction of trawlers and purse-seiners etc., in Kerala and Karnataka. The beneficiaries in both have been the better-off people among the fishermen and in many cases, persons who did not go fishing. These schemes thus helped only to accentuate the internal disparities in these communities.

Another major stream of development projects promoted formation of co-operatives among fisherfolk so that they could control marketing of their produce as well as have advantages in obtaining credit. Many of these too, have failed but a few has been able to survive. The basic reason for the failure of these attempts was that while in principle all members of a co-operative are equal, many co-operatives were controlled by the powerful persons from within the community and genuine participation was very low. However, in some co-operatives, the sponsoring agency was able to ensure equal footing to all the members, and the co-operative flourished. Before we can understand why this is so, we should study what is a fishery co-operative and what is its conceptual base.

2. The Fishermen Co-operative

In the context of this paper, we define a fishermen co-operative to be an association of fishermen established for attaining one or more objectives, functioning on the basis of economic participation, and structured democratically. Thus all co-operatives of fishermen, as well as societies other than co-operatives but functioning similarly, are included in this definition. However associations like trade unions, fisherwomen societies etc. are excluded. The basic assumption in all cases is that a membership in any of the fishermen organisations is purely voluntary and is by virtue of a person being engaged in fishing as the means of livelihood and not under any other consideration.

What should be specifically the structure and functions of a co-operative? While there is no clear cut answer to this we can examine one of the "proven" models. The Marianad Model. The key to this model is the economic independence of fishermen through control of marketing. Economic independence, it was thought, would pave the way for social equality. The basic features of the model were, the following:

(a) The organisation was democratic in functioning. The members had to be active fishermen and the supreme body of the co-operative, the General Body, consisted of all members. The governing body, called Managing Committee, was elected from the General Body. The Managing Committee handled all the routine as well as policy decisions of the co-operatives.

(b) The produce of all members were to be sold through the co-operative, and the co-operative was to take a certain percentage of the daily catch as its running expenses.

(c) A certain percentage was deducted as compulsory saving which was to be deposited in the member's name at the co-operative.

(d) The co-operative was to approach financial institutions for short and medium terms credit for its members. Loans given to members were to be deducted at source from the members, and paid to the banks.

(e) The co-operative was also free to carry out such activities like sale of fishing gear, procurement and bulk sale of fish to com-

panies etc. independently or in conjunction with other societies.

(f) The model envisages other non-economic and service oriented activities like educational and training programmes and cultural programmes to be executed by the co operatives when it is sufficiently sound in functioning.

Even though the model is only one of the possible alternatives, we can see that very broadly, any such organisation, to succeed should fulfil the requisities of both an economic institution as well that of a mass-based (democratic) organisation. To evaluate the performance of such organisations we have to develop a framework of parameters which would examine the organisation from these and other angles.

3. Parameters of Evaluation:

Before we can go into evolving parameters to appraise a co operatives, we should be clear as to what a "successful" co operative is. There are two dimensions to success in this context economical dimension and social dimension. A co operative has to be successful in both the dimensions to be called a 'successful' co operative. Economic indicators to success are such clear-cut concepts as economic/financial viability and profitability. Financial Viability of a co-operative is a necessary condition for its success. Whether it is also a sufficient condition is debatable, but that should not underrate the importance of this factor. A continuously subsidized co-operative is found, in most cases, to collapse as soon as the subsidies are withdrawn. A great many of the Government sponsored co-operatives share this fate. A co-operative, whose activities are on the ascending portion of its life-cycle curve may be unviable for an initial period and then attain viability. Thus it cannot be called successful until it passes on to the viable phase. Profitability of a co-operative is an indicator of the degree of its success. High profitability is not absolutely necessary for success, but is a strongly conducive factor for success. Since both these factors relate to the net financial benefits accured to the members, we can define economic viability as the condition when the co-operative is able to exist financially independent of outside sources, and cover all its operating costs on funds generated internally.

Equally important is the social viability of the co-operative. Social viability of a co-operative is more difficult to judge and its indicators are subtle. Social viability is indicated by active co-operation among the members, growth in membership, and several other related pointers. On the whole, social factors affect co-operation and hence, financial viability. These factors originate from inter-personal and intergroup dynamics within the co-operative and the outside environment. Social viability is affected also by the extent of democratic principles operating in the organisation, the level of social equality among the members, and internal leadership. While it is extremely difficult to pin-point what social viability is, we define it tentatively as the condition when the co-operative is able exist and function as a group of individuals, resolving internal & external conflicts from within.

From these definitions, we move on to determining, as exhaustively as possible, parameters with which we can judge whether a co-operative is successful.

These can be broadly classified as follows:

1. Financial Parameter
2. Member-benefit parameter
3. Participation parameter
4. Social-Benefit parameter

1. Financial Parameter

This is a factor representing the overall financial success of a co-operative. A co-operative would be defined as successful on this parameter if it is financially viable. The profitability of a co-operative, is an indicator of the degree of its success on this parameter. The co-operative which cannot meet its own overheads of functioning cannot be defined as successful.

2. Member-Benefit Parameter

This parameter represents the benefits accured to a member of a co-operative in comparison with non-members, and in comparison with himself before being a member. These benefits can be financial (higher price, bonus, dividend and so on) or service facilities like supply of fishing implements, reliability in payment, promptness in payment etc. This factor is a key factor as to why a member continues to offer his co-operation to the organisation. The pattern of benefits must be systematic so as to minimize any disparities within the members.

3. Participation Parameter

Here one tries to see the member's participation in the running, decision-making, and decision-enforcing process of a co operative. High participation is indicated by regular meetings of the Governing and General bodies of the co-operative, and high attendance in these meetings, as well as adherence to the norms evolved thereof. The existence of a single person who makes decision on behalf of the co-operative, however efficient he may be, indicates an anomaly and a low score on this parameter.

4. Social-Benefit Parameter

This is slightly broader in context, in comparison to the preceding parameters. This parameter indicates what the society at large stands to gain from the existence of the co-operative. Such benefits can be negative, zero or positive. In its constructive form, a co-operative can help to eradicate exploitative leaderships and traditional links and liberate its members economically. On the negative side, the co-operative may exploit the environment to the advantage of solely its members. The long term existence and growth of a co-operative is critically dependent on this parameter.

5. The Successful Fishermen Co-operaive-A case study

Vizhinjam is a fishing village in the southern part of Trivandrum District. It has a natural harbour from where the fishermen operate their craft all the year round. Fishermen of Vizhinjam are open to innovations, and various technological developments, plywood boats, outboard motors etc. have been readily accepted by Vizhinjam fishermen However, the system of bonded-labour was widely prevalent here. The amounts of bondage-indebtedness varied from Rs. 200 to Rs. 3000 depending on the assets for which the loan has been taken. In consequence, the fishermen had to sell their fish through these money lenders.

In early 1980, a small group of young fishermen decided to tackle collectively the problem of bonded labour. They further decided to sell their fish through person(s) appointed by themselves. With the help of a voluntary organisation, they raised a loan for Rs. 10,000/- cleared their debts, and appointed a salesman to sell their fish. Thus the Vizhinjam Fishermen Village Development Society was born. The society was latter registered under the Travancore Literary, Scientific and Charitable Societies Act.

The society then enlarged its operations gradually. It approached commercial banks and obtained credit for purchase of assets for its members. The repayment was through

deducation at the source and the Society remitted the money periodically at the bank. For keeping track of accounts, the society appointed a clerk, raising the member of staff to two.

Meanwhile, quite a lot of other fishermen also wanted to redeem their bonds and join the society. The society had returned their initial loan of Rs. 10,000/- and had not much money left. They also wanted to be sure of the bonafides of the applicants. For this, the society evolved a rule: the persons desiring to become members should remit regularly for a period of time 2% of their income as savings in their name at the society, while continuing selling fish through their money lender. The regularity of this remittance would decide whether they could be given membership.

With the money generated from their activities and remittances from members to be, the society increased its membership by redeeming the loan of these new members. Thus the membership rose to its present level of 235 and the society expects assistance from banks or others external sources to repay loans of the other persons waiting to become members. The relationship of the Society with the bank was good, as the society had been repaying its loans promptly. It was in a position to get loans for its members in most cases, except when the banks had internal constrains. The society had also made operating profits about Rs. 22,000/- in its four years of operation. It held General Body meetings every month and Managing Committee meetings every week. In the future it hoped to liberate as many fishermen from bondages as it could and build up the society as a strong and capable institution, serving not only the members, but also the whole village. (*See Appendix*).

5. Requisites of a Successful Co-operative

We have seen in the preceeding sections what a fishermen's co-operative is, and what the requirements for its success are. We have evolved, parameters to determine whether a co-operative is successful. In the case study, we have seen these parameters in actual operation. We can now determine what are the fundamental requirements of a successful co-operative. These pre-requisite are in fact latent, and are manifest only indirectly as the performance of the co-operative. Thus these and the parameters we have evolved, have a cause-effect relationship. Broadly, these requisites are:

—Internal Leadership

—Quality of membership

—Logic of operation

—Environmental factors and

—Government policy

Internal leadership related to the quality of the leadership available within the co-

Appendix I

Year	No. of members	Total Fish Sales	Profit (Loss)	No. of loans	Amount of Loans
1982	62	2,02,944.00	(1333)	23	14,800
1983	75	4,67,930.00	(6144)	20	90,000
1984	205	10,23,385.83	8644	35	75,000
1985	240	21,34,484.00	28,832	29	2,57,860

operative. It is seen that leadership, though qualitatively affected by such factors as education, family background etc., is found in all levels of society. Here it is important that the available leadership should be developed and made responsible to the objectives of the co-operative, here the contribution of NGO's is very important as the local leadership may not be in a position to take up responsibilities of the co-operative off hand.

Closely related to this, is the quality of membership. This actually is a profile of the co-operative on the dimensions of age-group, education, occupation etc. Usually dynamism of the co-operative has a close relationship with the proportion of younger members. A group consisting only of fishermen in the 35 plus age group, may be lethargic and also closed to new ideas. The correct policy of a stable co-operative should be to give membership to the younger members periodically rather than to remain a closed group.

Logic of operations refers to the underlying economic and social needs on which the co-operative is organised. Often, this logic determines the fate of a co-operative. A fish marketing society may not take off in an area where fish production is low. It is also to be understood that this logic is dynamic the need that existed when the co-operative was formed might vanish when it takes off, due to the stabilizing effect that is seen when there is disequilibrium. This explains why a co-operative may have to diversify in its operations.

Environmental factors are various social norms, physical disabilities and economic constraints that a co-operative has to encounter. As seen in the case of Vizhinjam Fishermen Society where bondages among fishermen was prevalent, the co-operative has to adapt to these factors, in many cases as contraints.

Government policy is also a constraint, as the co-operative in general can do little to affect Government policy. Though in most cases policy has been with good intentions, if often ends up as a constraint for the co-operatives and its members. Even for specific schemes like IRDP which includes fisherfolk as a target group, has been alleged of being over-ridden with red-tape. This can change for the better only when there is a certain amount of representation from the co-operatives at the policy formation process.

The success of the co-operative, thus is a function of all these factors. The ways of interaction of these factors in the co-operative varies widely over time: policies change, activities may need to be enlarged in scope, membership patterns change and so on. This reflects the need for the co-operative to be dynamic in its operations. It should be aware of all these changes and of the implications of these changes. It should diversify its operations as and when necessary. As can be expected, the co-operative may not have internal resources to cope with such problems Hence there is a district need for a body that can effectively deal with these problems and serve as a forum for many co-operatives, Apex bodies are thus a direct extention of the philosophy of co-operatives.

6. Summary & Conclusions

Fisheries is quite different from the agricultural sector, and fisherfolk, especially traditional have been severelly marginalised historically. One stream of development work aimed at the development of fisherfolk was through the formation of co-operatives. But in places where balanced participation was not ensued, these attempts had failed Marianad model was one model of formation of fishermen co-operatives. The modle

assumed democratic structure and economic participation, and utilized economics of scale and collective bargaining.

A fishermen co-operative was successful only when it was separately an economically viable unit and was able to function as a coherent group, able to sort out differences internally. To evaluate the performance of a co-operative, certain factors serve as indicators. These are financial performance, participation, social benefit and individual benefit obtained. These factors are individually necessary and collectively sufficient for the success of a co-operative. The case study illustrates the dynamics of a successful co-operative.

The factors that ensure the success of a co-operative have been identified as internal leadership, membership quality, basis on which activities of the co-operative are constituted, environmental factors and government policy. All these factors are dynamic and the co-operative has to be responsive to changes in them. Apex bodies. which are an extention of the basic philosophy, can help primary co-operatives in tackling problems which they may not be able to solve alone.

Acknowledgements

1. John Kurien, Centre for Development Studies, Trivandrum.

2. V. Vivekanandan, Manager, South Indian Federation of Fishermen Society, G.B.R. Buildings, Overbridge,Trivandrum.

Modus Operandi for Fishermen's Cooperatives: A Note

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ABSTRACT

What we see in most maritime states of India today is the consequence of a flawed understanding of what co-operatives really are. A co-operative is at once a people's organisation and a business organisation; though for the purpose of study and analysis we might separate the two dimensions, it is meaningless in reality to do so. If a co-operative fails as a people's organisation it will most certainly fail as a business organisation—there is no exception to this rule.

The malady of co-operative enterprise all over the world has been its inability to come to terms with this most fundamental tenet of co-operation. Fishermen's co-operatives have been afflicted with the same malady; they have suffered the same fate.

There are two dimensions to the issue of organisation of fishermen's cooperatives, which we must recognise. They are: (1) the dimension of a village cooperative as a people's organisation; that is, the sociological dimension and (2) the dimension of the cooperative as a business organisation; that is, the economic dimension.

Although these two dimensions cannot be separated, it is essential that we isolate the two in order to better understand both.

Here we will deal with the economic dimension only. This dimesnion is mainly concerned with the three main functions of providing credit, supplying craft and gear and marketing fish. Although all the three are equally important, it is the tackling of the last function—the marketing of fish—that will ensure the continued operation of a fishermen's cooperative. Providing credit and supplying craft and gear are essential functions, but they can never become viable unless they are linked to the whole marketing function.

To start functioning in this manner on the shore is of course to start with the concrete reality. What the cooperative undertakes to do is primarily to sell every fish belonging to its members in the most suitable manner, and shoulder the responsibility of collecting the dues from the fish distributors. The cooperative could collect a small service charge from members for the risks undertaken and services performed.

Subsequently, the cooperative will also have to provide credit for productive purposes, which will in the short and long run increase the member's productivity and the quantum of fish sold through the cooperative, thus increasing its earnings.

Consequently, if loans and savings schemes are introduced into cooperatives, better capital rotation and capital formation would be the result and this would in turn facilitate credit. Thus a credit-production-marketing-savings link would be established within the cooperative.

In effect what this amounts to is a recognition of the fact that no primary fishermen's cooperative can hope to succeed by being a uni-purpose organisation—whether the purpose be for credit or marketing. The economic aspects of fishing are so closely interlocked that the attempt to handle a single operation by a new method merely arouses opposition and counter-measures at some other point in the fish economy.

In other words, a primary cooperative should be multi-purpose in function and flexible in character. It should gradually widen its functions to touch all the economic aspects of its membership, whether or not these functions are directly connected with the fishing operation.

Only such a planned and organised effort, basically controlled by the fishermen themselves, will ensure that the benefits from greater productivity generate higher returns for the fishermen, more earnings for small distributors of fish (who should be encouraged to buy fish only from such cooperatives) and fair prices for rural consumers.

The Genuine Hierarchy

Only when such a strong base of primary cooperatives handling the "essential" services has been created, is there any meaning in organising secondary and apex cooperatives that can undertake more complex services.

The basic function of the secondary and apex cooperatives—like that of the primaries-will be to create the credit-production-marketing savings link, but on a much larger scale and over a wider area. They will also have to undertake other services that are not directly related to the fishing operations—such as provision of relief and welfare measures, organisation of insurance schemes and old age pension, planning for future development, extension of legal advice.

For the sake of clarity, we can split the function of secondary and apex cooperatives into two categories:

(i) "dependent functions"—those that arise from the coordination of the essential services performed by the primaries.

(ii) "autonomous functions"—those that are performed independent of the activities of the primaries.

Circumstances in most maritime states of India have led to the creation of secondary and apex cooperatives from above; they have not sprung up from below in response to a genuine need. The secondary and apex cooperatives are attempting to undertake the dependent functions by themselves, and in this process becoming "institutional merchants" rather than coordinating cooperatives. As we indicated earlier on, such attempts produced very unprofitable ventures and ultimately served no useful purpose apart from adorning the theoretical three-tier cooperative structure.

Conclusion

What we see in most maritime states of India today is the consequence of a flawed understanding of what cooperatives really are. A cooperative is at once a people's organisation and a business organisation; though for the purpose of study and analysis we might separate the two dimensions, it is meaningless in reality to do so. If a cooperative fails as a people's organisation it will most certainly fail as a business organisation–there is no exception to this rule.

The malady of cooperative enterprise all over the world has been its inability to come to terms with this most fundamental tenet of cooperation. Fishermen's cooperatives have been afflicted with the same malady; they have suffered the same fate.

Recommendations of Session III

1. The criteria for giving special benefits to fishermen should take into consideration whether the candidate is actually engaged in the fishing work, rather than fishermen by birth or by management.

2. It is necessary that on many items of development, the fishermen should be helped to get due share under a minimum needs programme. However, there is need to alleviate some of the special disabilities experienced by them.

3. Income generation and thrift are very important. For income generation, the use of appropriate technology is important.

4. Mechanisation has in its wake created some problems of unemployment and change from owner fishermen to workers on larger boat.

5. It is uncertain whether the benefits of mechanisation have been equitably shared and reached the actual fishermen.

Session IV: PROCESSING INDUSTRIES

Constraiats in Exporting Frozen Shrimp and other Fishery Products from Karnataka

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ABSTRACT

Of 63 processors who froze prawns in Karnataka for export since 1960–62, only 8 have remained in the run. Export of prawns is no longer a profitable avocation, many processing plants have closed down and the export is declining in terms of quantity, year by year.

Excessive competition among exporters, static levels of production, high cost of diesel for the boats, steady increase in cost and restrictions in consumption of electricity, purchase tax on prawns, cess imposed by MPEDA, export inspection fee collected on F.O.B. value basis—all these costs are adversely affecting the viability of the industry, and its survival is at stake.

Locating new fishing grounds for prawns, encouraging deep sea fishing and brackish water prawn culture, providing fuel and electricity at low costs and several other remedial measures aimed at ensuring survival of the industry are now essential.

Karnataka has a coastal line of 300 KM. fringing Uttara and Dakshina Kannada Districts with a continental shelf area of 25,000 Sq. KM. There are 43,952 full time fishermen (19,260 in Uttara Kannada District and 24,692 in Dakshina Kannada) in 151 fishing villages with 77 link roads, linking National Highway with about 14 fish landing centres which provide berthing facilities for mechanised boats.

There are three sectors of fishing in the state i.e. traditional fishing, trawling with mechanised boats, and purse-seining with powered vessels. In the last six years there is such a change in the complexion that trawling and purse-seining operations now make a major contribution to the fishery of the area.

Mackerels and oil sardines contribute 50–60% of total marine landings of the State and balance are prawns and other edible fish. Mackerels and oil sardines are mainly consumed in internal markets whereas prawns have good export market.

Fish processing Industry was started in Karnataka in 1960–62 and so far about 63 Processors exported prawns and out of which about 8 processors have remained in the run. Export of marine products is no longer a profitable avocation. Unable to absorb the mounting losses, many processing plants have closed down. The situation is gloomy. Seafood Export from the State is about 3000 tonns annually, valued at about Rs. 17 crores. However, inspite of increased fishing efforts, the export of frozen shrimp in our State is declining in terms of quantity, year by year.

The main reason for this state of affairs is the non-availability of raw material for processing at a workable cost. Excessive competition from exporters who have to

meet a target and static production level have brought about this situation. For the survival of the Industry, the only solution is to produce more of prawns by adopting deep sea fishing and by brackish water prawn culture.

India's Exclusive Economic Zone covers 2 million Sq. KM. and the Karnataka State covers about 87,000 Sq. KM. The economic potential of our sea area has a promise of gigantic financial returns. But all depends on how much we know about the area and where to find fishing grounds. Exploratory Fisheries Project which does the job should be upgraded to meet the challenge. Its existing performance with 28 vessels operating just 126 days on an average in a year and that too, close to the shore would bring in no positive help to the industry. Therefore the time is now ripe for re-organising the project into a more dynamic and purposeful body. Otherwise the Exclusive Economic Zone will be exploited by poachers rather than the legitimate operators if faster development is not planned immediately. The Government may provide as a developmental measure certain incentives to processors to acquire fishing vessels. They may be allowed to charter fishing vessels, exempting them from the requirements of bank guarantees and other conditions which would be difficult to fulfil. They may also be permitted to import fishing vessels.

The Ministry of Agriculture, while providing susidies on several inputs in the field of Agriculture has denied the same treatment to the Fishing Industry. Ours being a 100% export oriented Industry, we request the Ministry to provide diesel oil at a reasonable rate. Even larger houses are slowly backing away from the field on account of their higher cost of operation. Fish Industry is being ruled by many departments. While production was looked after by the Ministry of Agriculture, most of the incentives that were provided for the Agriculture sector were denied to the fishing Industry. Again while several incentives were provided for Industrial output, marine products processing and Export Industry was denied of such incentives. The exclusive Small Scale Seafood Processing and Exporting Units may be treated at par with Agriculture products and given the full exemption of Income Tax.

Day by day the Karnataka State Electricity Board is putting more and more restrictions on the consumption of power. Electric supply is stopped for 4–6 hours daily and recently they have imposed 10% power cut even to large cold storages and ice Plants, which were hitherto exempted from power cut. They have also started charging 25% of the total consumption at a much higher price than the normal tariff, claiming the rate of "HIGH COST ENERGY".

Seafood exporters are under heavy tension due to Purchase Tax. Our State Government is squeezing the Industry by the neck by introducing 4% purchase tax on the purchase of raw material i.e. prawns. Even though amendments were made in the Central Sales Tax Act as back as 1976, our State Government has ignored it conveiniently. For this purpose, the Union Government should issue clear orders to State Governments. Moreover, our State Government is proposing 1% on value of prawns as cess of Agricultural Produce Market Committee. While the Industry has to compete in the International market with other seafood exporting countries, this additional burden of purchase tax and APMC cess, make our products more costly and thereby make it nearly impossible for the exporters to compete and run their

Industry. With this attitude of the Government, we feel that the Industry may not survive for long, as the processors and exporters are not in a position to clear the purchase tax and APMC cess, while simultaneously offering attractive rates to the fisherman for their produce in order to run the fishing operations economically viable. With the highly competitive export market the prices are more often dictated by the overseas buyers. Even though there are trade promotion officers of MPEDA in major exporting countries there is lack of communication regarding major price fluctuation, demand variation and prices offered to other exporting countries.

The Exclusive Seafood Processors and exporters should be declared as 100% export oriented units and given the full benefits available to other 100% export oriented units in our Country. Since no local sales or import of raw prawns are involved in our trade, exemption from customs bond and other formalities may be given to this Industry. Also, exclusive Small Scale Processors and Exporters may be given 30% cash subsidy on their total investment for constructing new factory and also for purchase of machinery. This will enable Seafood Industry to get modernised and go for value added products and thereby get more foreign exchange for our country.

MPEDA is collecting huge amounts by way of cess @ 0.5% from Seafood Exporters. Since the sale value of shrimp has been considerably increased, the cess collected is quite high and should be reduced to 0.25%.

There is much scope for prawn culture, in both the maritime districts of Karnataka. For the last few years, export of Shrimp from India is more or less stagnating at about 50,000 tons, in spite of increased fishing efforts. This stagnation from capture fisheries particularly shrimp/prawns, has brought out an awareness on promoting aquaculture to boost up export production. But raw material for export from shrimp farming is yet to make a headway. The only difficulty is that our people are not specially trained in it. The MPEDA through its field offices has been extending technical guidance to Agriculturists for undertaking shrimp farming through scientific culture practice. Unfortunately prawn culture requires substantial funds for the construction of bunds, sluice gates, etc., Ours being small holdings, it may not be economical to develop a small farm. Therefore the Government should come forward to grant the adjacent lands to the land holder at a nominal rent, so that he can have a bigger and more economic holding. The Port Trust, Forest Dept. and Revenue Department should jointly come to an understanding that the waste land near the Sea or river-bed be given to the enterpreneur for developing prawn culture at a nominal rent on long term basis, so that one can safely invest money for bunds and sluice gates, for development of prawn farms.

The latest big jolt the industry faces is the introduction of Export Inspection Fee collection on F.O.B. Value basis, imposed by the Export Inspection Agency. The present system has created many problems to the exporters at the time of actual shipment. The exporters have to pay now more than double the charges, when the industry is actually in a limping stage.

The Seafood Export Industry is our nation's vital foreign exchange earner and hence requires greater protection and nurture. I am sure that Central as well as State Government will successfully come to our rescue and save this Industry.

Promotion of Seafood Exports from India with special reference to Karnataka's Resources—A Projection for 7th Plan Period

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ABSTRACT

The trend of seafood export from Karnataka in recent years is outlined as against the performance at all India level. The resources available in the State which can be utilised for the export trade are described. Methods for the augmentation of shrimp production by farming are suggested. The need for modernisation of our freezing plants is stressed. The subsidy schemes introduced by the Marine products Development Authority for upgrading the efficiency of the industrial units are listed. In conclusion, the role that Karnataka State can play in achieving the Rs. 700 crore export target for the country by the end of the 7th five year plan, is envisaged.

1. Overall Performance

The overall exports of marine products effected from India during 1985–86 rose to an all-time high. The exports were of the order of Rs. 398.00 crores as against the previous year's Rs. 384.29 crores. The growth rate was at 3.6% in 1985–86 as against 3% recorded in 1984–85. Foreign exchange earned by some of the major items including frozen shrimp, frozen lobstertails, frozen cuttlefish and frozen squids during 1985–86 were also the highest on record. Due to sharp rise in export prices, particularly for some of our major items, the average unit value realisation of our exports rose sharply to a record level of Rs. 47,580 per tonne (Rs. 47.58 per kg.) in 1985–86 as shown in Table 1.

However, the overall exports in terms of quantity suffered a 2.9% fall, from 86,187 tonnes in 1984–85 to 83,651 tonnes in 1985–86. This fall could mainly be attributed to the significant decline in the exports of frozen shrimp (by about 5,050 tonnes) and dried fish (by about 3,677 tonnes) on account of the unprecedented poor catches of shrimps as well as commercially important species of fish like Anchoviella all along the Indian coasts.

Table 1. Export Growth of Indian Marine Products

Year	Qty. (tonnes)	Value (Rs. crores)	Average Unit Value (Rs./Kg.)	Growth Rate	
				Qty.	Value
1981—82	71015	286.01	40.80	— 7.26%	+21.79%
1982—83	78175	361.36	46.22	+11.51%	+26.35%
1983—84	92691	373.02	40.24	+18.57%	+ 3.23%
1984—85	86187	384.29	44.58	— 7.02%	+ 302.%
1985—86	83651	398.00	47.58	— 2.94%	+ 3.57%

2. Performance of Individual Items

Eventhough frozen shrimp continued to dominate the trade during 1985–86 as well, its share in the overall exports has slumped from 64% in 1984–85 to about 60% in 1985–86 in terms of quantity or from about 86% to 83% in terms of value. Meanwhile, items like frozen lobstertails, frozen cuttlefish and frozen squids have made spectacular progress in the export front.

Among the frozen items, excepting shrimp and froglegs, all others have improved their exports both in terms of quantity and value. In the case of frozen shrimp, the exports in terms of quantity sharply declined while the value of exports was well maintained at the previous year's level. The frozen froglegs exports suffered both in terms of quantity and value. Similarly, exports of canned as well as dried Fishes have also suffered a set-back during 1985–86 as could be seen from the Table 2.

Table 2. Itemwise Exports of Marine Products from India
(1985–86 and 1984–85)

Q: Quantity in tonnes
V: Value in Rs. Lakhs

Item		1985—86	1984—85	Increase Decrease (actual)	(+) (—) (percent)
Frozen Shrimp	Q:	50349	55398	—5049	(9.11%)
	V:	32981.87	32969.54	+12.33	(0.04%)
Frozen Froglegs	Q:	1746	2778	—1032	(37.15%)
	V:	742.73	777.49	—34.76	(4.47%(
Frozen Lobstertails	Q:	1650	1082	+568	(52.50%)
	V:	1445.28	789.10	+ 656.18	(83.16%)
Frozen cuttlefish/Fillets	Q:	5010	1966	+3044	(154.83%)
	V:	1080.45	509.50	+570.95	(112.06%)
Frozen Squids	Q:	4619	1663	+2956	(177.75%)
	V:	551.93	300.20	+251.73	(83.85%)
Fresh/Frozen Fish	Q:	10561	9091	+1470	(16.17%)
	V:	1714.98	1439.80	+275.18	(19.11%)
Canned Shrimp	Q:	12	29	—17	(58.62%)
	V:	6.05	20.49	—14.44	(70.47%)
Dried Fish	Q:	8151	11823	—3672	(31.06%)
	V:	761.39	999.66	—238.27	(23.84%)
Dried Shrimp	Q:	73	80	—7	(8.75%)
	V:	5.48	10.75	—5.27	(49.02%)
Shark fins & Fish Maws	Q:	231	249	—18	(7.23%)
	V:	312.00	338.92	—26.92	(7.94%)
Others	Q:	1249	2023	—774	(38.26%)
	V:	197.82	273.52	—75.70	(27.68%)
Total	Q:	83651	86187	—2536	(2.94%)
	V:	39799.98	38428.97	+1371.01	(3.57%)

3. Karnataka's Export Performance

It is normal to consider the shipments of marine products made through the ports of a particular State as the exports effected by that State. In 1985–86, the seafood exports handled by the Mangalore Port (the only port-available for seafoods export in Karnataka) were of the order of 1517 tonnes valued Rs. 6.98 crores. This works out to 1.8% in terms of quantity or 1.75% in terms of value of the total exports of marine products from India. As could be seen from table 3, the exports made through the Mangalore Port have been steadily declining since 1982–83:

However, the exporters in the region were not making the entire shipments through the Mangalore Port alone. Parts of their cargo meant for Japan, USA, and European markets are also shipped through other ports like Cochin, Goa and Bombay. Taking into account all the exports of marine products effected by the exporters of the State through all these ports, it is estimated that Karnataka's exports amount to about 3,350 tonnes valued Rs. 14.50 crores. Even though the export through Mangalore Port has registered a fall over the years, the overall exports from the State have been more or less steady at this level.

An organised system of production and export of dried marine products was initiated in Karnataka in the early period of this century. In earlier days, the dried seafood cargo had to be carried all the way to the port of Tuticorin by sail boats or country crafts for shipment to the prospective markets. An alternative system adopted when sail boats were not available was to take the cargo by rail to Dhanushkodi for shipment. This method continued till the 1950's when cargo/passenger ships from Gulf areas calling at Mangalore port, made themselves available for the purpose. Initially the steamships that carried dried seafood cargo from Mangalore to Sri Lanka were Sheela Margret and Margret Rose which called at the Old Bunder, Mangalore in around 1955.

4. Development of Freezing

The commissioning of Mangalore Ice-cum-freezing plant with one Ice Plant of 5 tons/day, one freezing plant of 5 tons/day, one cold storage of 68 tons and one frozen storage of 80 tons at Mangalore in the early fifties heralded a new era in the seafood export processing Industry in Karnataka. Realising the high potential inherent in the industry as an important foreign exchange earner for the national exchequer, the State Government of Karnataka initiated quick steps for increasing the fish and prawn landings. By 1958, a certain amount of mechanisation of fishing crafts was achieved. Increased landings of the main dollar earner

Table 3. Export of marine products

	All INDIA		Exports through Mangalore Port			
Year	Qty. in tonnes	Value Rs. Crores	Qty. in tonnes	Value Rs. Crores	Qty. %	Value %
1980—81	75591	234.84	4520	12.04	5.98	5.13
1981—82	70105	286.01	3524	13.07	5.03	4.57
1982—83	78175	361.36	4166	17.90	5.33	4.95
1983—84	92691	373.02	3141	12.51	3.39	3.35
1984—85	86187	384.29	2718	11.47	3.15	2.98
1985—86	83651	398.00	1517	6.98	1.87	1.75

item namely, prawns, attracted quite a number of enterpreneurs into the field. A proliferation of freezing and canning units all along the Karnataka coast was the result.

There was a sudden spurt in the processing activity which resulted in the establishment of about 31 freezing units in Karnataka by 1970. At present only 22 freezing units are operating in Karnataka out of which only 9 units are actively engaged in exports and a few are concentrating in internal marketing of frozen fish and the remaining are more or less lying idle.

5. Development of Canning

The canning sector also developed along with freezing industry and it flourished till the 1970's. Due to the growing demand for frozen products coupled with high cost of the tin containers, the canning sector suffered a set back in the export field by the middle of 1970. Raw material ceased to be available at economic prices to the canning sector and our canned shrimp became uncompetitive in the foreign markets. At present only 6 units in the state are in operation catering to the internal markets as well as to meet the defence service requirements.

6. Fishery Resources

Karnataka is one of the maritime states on the west coast with geographical area of 1,91,791 Sq. Km. Out of the 19 districts in the state, South Kanara (Dakshina Kannada) and North Kanara (Uttara Kannada) are the only two maritime districts.

Karanataka coast, popularly known as the "mackerel Coast" of India abounds in pelagic resources. The State's marine fish landings every year have been influenced by the wide fluctuations in the pelagic fishery which is dominated by mackerel and sardine. These two species together account for around 70% of the total landings of the state. The prawn fishery contributes another 7–10% to the total. Cat fish, shark, ribbon fish, silver belly, pomfret, seer fish, Sciaenids, sole and Lactarius are other groups landed on the coast. The total marine fish landings for 84–85 is 1,68,046 M/T. which shows about 63,756 M/T. increase over the previous year. The peak landing of 1.91,026 M/T. was recorded during 1979–80. The marine fish landings for the last 9 years were shown in Table 4.

Table 4. Marine fish landings along Karnataka coast

Year	Fish Landings
1976—77	62,785
1977—78	1,26,726
1978—79	1,66,995
1979—80	1,91,026
1980—81	1,60,703
1981—82	1,45,377
1982—83	1,04,055
1983—84	1,04,290
1984—85	1,68,046

Statistical bulletin 1984–85, Dept. of Fisheries.

In recent years, there has been heavy concentration on fishing efforts in this region leading to lesser production per unit effort affecting the fortunes of fishermen. Presently, there are about 400 purse-seiners, 2100 trawlers, 700 gillnetters and 10,000 non-mechanised boats operating along the coast of Karnataka.

7. Augmentation of Shrimp Production

Till now shrimp constituted about 84% of the total exports from the state. Nearly 90% of exports is to Japan and hardly 10% is for other markets including USA. Though it indicates an over-dependence on one product and one market, one cannot set aside the vital position of shrimp

in the export front. In this context there arises the need for strengthening the production of shrimp. Dering the last 5 years catches of Prawns show a wide fluctuation Table 5.

Table 5. Prawn cathes along Karnataka coast

80–81	81–82	82–83	83–84	84–85	(Qty. in tonnes)
9494	5349	8564	7142	8749	

Since there is only a limited scope to improve the landings by capture fisheries, the need for strengthening the production of shrimp by culture fisheries becomes quite inevitable considering the vast areas of barckish water available in the state for prawn farming. Karnataka has a brackish water spread of about 8,000 hectares of which 4,000 hectares hold good promise for development. The State's back water abounds in seeds of cultivable species of prawns. In Uttara Kannada there exists a traditional system of prawn culture in about 600 hectares of gazniland. Total gazniland area in Uttara Kannada were the Kagga variety of paddy is cultivated in the monsoon season lying adjacent to thc coast is estimated as 4,000 to 4,500 hectares.

Marinc Products Export Development Authority of India has set up a Sub-Regional Centre at Karwar in 1982 for assisting the farmers with necessary technical know how and inputs required for adopting sceintific methods in farming. The assistance rendered by the Sub-Regional Centre of MPEDA at Karwar area:—

1. To survey and select water areas suitable for prawn culture,
2. To prepare feasibility reports for the farmers to enable them to secure loan facilities from Banks.
3. Supply of essential inputs like quality seeds and Mohuwa oil cake at cost price wherever necessary,
4. Prawn seed collection and supply of larvae,
5. Maintenance of nursery for rearing prawn larvae,
6. Periodical monitoring of farmers' ponds during the period of culture and suggesting proper scientific methods of management,
7. Extension service in promoting commercial prawn farming through demonstrating culture methods.
8. Training to farmers interested in prawn farming,
9. Preparation and distribution of literature on prawn culture,
10. Undertaking research for development and improvement of prawn culture.

Considering the available area for prawn farming in Karnataka, it is estimated that an additional of shrimp can be produced in a year by culture and resorting to scientific methods of farming 6400 M/T. In order to encourage prawn farming, MPDEA is operating a number of subsdy schemes.

Although shrimp is the major item of export there are other potential items like seer, tuna, mackerel, sardine, pomfret etc. offering high potential for export marketing. In recent years a new marketing avenue has been opened in the Gulf countries for the export of the above mentioned itoms. During 84–'85, 25 Tonnes of frozen mackerel and 32 Tonnes of frozen seer fish were exported to the Gulf markets. With the introduction of two important Japanese tuna vessels which have started operation off Mangolore coast, the landing of tuna is likely to increase and this will result in the

export of this particular variety of fish. A beginning has been already made in 1985–86 when as much as 131 tonnes of frozen tuna have been exported.

Need for modernisation

The seafood processing industry to this day is following conventional methods of processing. A good number of freezing plants in operation were set up years ago and the efficiency of these equipments have been deteriorating over the years. However, the small scale entrepreneurs having been tied down with their investment have not been able to go in for any further additional investment for replacement of the old machinery and installation of new equipments to improve their efficiency. At the same time the need for modernisation of the industry became increasingly felt. Realising the need for such changes and in order to upgrade the efficiency of processing/storing units, the MPEDA has introduced the following subsidy schemes.

Item	Extent of subsidy
1) Generating set	15% or Rs. 40,000/-
2) Freezing units	20% or Rs. 1 lakh
3) Refregeration units for trucks	33.3% or Rs. 45,000
4) Chip/Flake Ice Making Machine	25% or Rs. 1 lakh
5) Mini Lab	50% or Rs. 50,000
6) Cold Storage	25% for improving installation & 25% for upgrading diff-users–maximum Rs. 75,000
7) Technologists of MIPQC units	Maximum Rs. 15,00 per month
8) IQF Machinery	25% or Rs. 15 lakhs

As could be seen from the above a liberal policy of extending financial assistance for modernisation of the industry has been introduced by the MPEDA. It is now upto the industry to make use of the above incentives in order to modernise their units so as to meet the challenges in the international market.

Conclusion

The Indian Ministry of Commerce has envisaged an export target of Rs. 700/- crores by the end of the 7th Five Year Plan (1989–1990) for marine products. At the commencement of Sixth Five Year Plan in 1980–81 export of marine products fetched Rs. 234.84 crores. By the end of the 6th Plan period 1984–85 the value of India's export of marine products reached a level of Rs. 384.29 crores.

As per the present outlay, the export target to be achieved during the 7th Plan period is as follows:—

	Qty. (MT)	Value (Crores)
1985–86	87,550	402.68
1986–87	1,11,600	500.00
1987–88	1,20,500	560.00
1988–89	1,29,400	630.00
1989–90	1,38,300	700.00

By modernisation, augmentation of shrimp production, adopting scientific farming and by way of diversification, it can reasonably be hoped that Karnataka will be able to step up her share in the over all targetted exports of marine products during the 7th Plan Period.

Fishery By—Products Industry in Karnataka

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ABSTRACT

The meaning of 'Fishery By products' is explained. The raw material resources, on which the fishery by-products industry of Karnataka State can depend, are detailed. The present status of fish curing, fish meal and oil manufacture, production of chitin, chitosan and other items as important industries of by-catch' utilisation, is analysed. Some problems encountered in this sector are discussed.

Fishery raw materials which, for one reason or another, are either not used in fresh, frozen or canned form or are unsuitable for human consumption, form the basis for production of "fishery by products" This does not preclude deriving a by-product which is itself suited or intended for human consumption, even if the raw material may not be. Such raw materials may be: (1) wastes from fish processing industry, and (2) materials from fishing operations.

Wastes from fish processing industry: Inedible portions of fish carcass such as entrails, scales, skin, fins, bone, head, exoskeletons from crustacea which are discarded from: (1) gutting and filleting operations, (2) curing, (3) canning, (4) freezing, or (5) other fish processing industry—these form one class or raw materials for fishery by-products.

Materials from fishing operations: Fishery raw materials, derived from fishing operations, which for reasons of species, appearance, size, quality, lack of processing capacity or market, are either not suited or cannot be used for human consumption, form the other, but quantitatively the more abundant class of raw material for fishery by-products. These include the so-called "trash fishes" which are also termed "by-catches" or "incidental catches", seasonal glut landings, and also the yet unexploited stock which the sea holds.

Quantitative aspects

On an average, about 50% of whole fish comprises inedible parts. Where fish is marketed in the round, this inedible portion is discarded at the level of the consumer and becomes unavailable for industrial utilisation. When fish are gutted, filleted for direct marketing or freezing, or dressed for curing, canning or other processing, this inedible matter accumulates for possible conversion into by-products. If the quantities are too small or the value derivable from possible by-products be not attractive, there turns out to be little scope for utilising the inedible wastes. From this point of view, it is only prawn shells from the freezing industry that are available for conversion into by-products in Karnataka. Freezing and canning of fish in the State at present are too limited to admit economically viable conversion of their wastes into by-products. One could perhaps advocate centralised gutting and filleting of much, if not all, of the medium and large size fish distributed and marketed as fresh in the round, akin to

the abattoir, so that the inedible portion is available in such centralised locations. However, this requires far-reaching changes in the marketing system and consumer attitudes.

Of the total landings of marine fish in Karnataka during the 5 year period between 1980–81 and 1984–85, the minimum and maximum quantities utilised for curing are 17.2 and 33.1%; for reduction 3.6 and 12.0%; and for manure 4.0 and 13.0% (Table 1).

FISH CURING INDUSTRY

Fish preservation by salting and/or sun drying is yet the least expensive processing method and perhaps the only one that keeps costs sufficiently low for the end product to be within the reach of people of low income groups. Apart from being comparatively the easier and cheaper way of dealing with local surpluses of sardine, mackerel and other fishes, for certain other types of fishes like shark, anchovies, ribbon fish, soles and others, the consumer preference is for the dried rather than for the fresh form. This method of preservation has therefore an important role to play, as little capital investment is involved and costs of production, storage and transport are lower. Further, this provides subsistence for a large number of fishermen in the coastal villages and even a lucrative occupation for some. In trade, dried fish is an important commodity.

It has been repeatedly pointed out that it is possible and necessary that cured fish products of much better quality than at present available in the markets should reach the consumer. Lack of sanitation and hygiene in fish handling during dressing, salting and drying operations is also recognised. Fish curing yards run by the State Government decades ago were effective when subsidised salt was being provided in the curing yards. Subsequently, these yards remained unused. In more recent years, a few curing yards have been provided by the State Government through the fisheries co-operatives. These yards, however, are not put much into use.

Improvement of the fish curing industry along desirable lines is not perceptible anywhere. It is possible that the very structure of the cured fish industry and trade in the product have inhibited improvement of the industry. The curers depend on low profits on quick returns, speculate and sell their produce at the first opportunity. The traders and merchants can only deal with the products they buy; they too speculate and depend upon quick returns. The cost of

Table 1. Disposal of Marine Fish Landings in Karnataka by means other than fresh fish marketing, freezing and canning*

	1980—81	1981—82	1982—83	1983—84	1984—85
Total landing in 1000 metric tonnes	160	145	104	104	168
Percentage utilised for:					
Curing	17.2	17.6	24.6	28.5	33.1
Reduction	10.1	12.0	5.9	3.6	4.0
Manure	5.9	13.0	6.3	6.7	4.0

*Based on statistics provided by the State Department of Fisheries.

loss of product or product quality in the trading chain is passed on to the final link, with the consumer paying for everything. Thus, there is no incentive for the primary producer, i.e. the curer to produce better products, nor for anybody in the trade chain to care. The consumer must be satisfied with what he gets.

There are possibly one or two ways of dealing with this situation. The first one would be to do nothing as hitherto and let the normal production, trade and market linkages work out their own course. Alternatively, if there is any desire at all on the part of governmental or other agencies to help improve the industry, a thorough socio-economic survey of the structure of the fish curing occupation and the dry fish trade may be undertaken with a view to provide effective inputs to the poorer primary producers. Occasional attempts to provide inputs for fish curing yards through co-operatives does not even touch the fringe of the problem. It constitutes available expenditure as only a few, if any, are benefited.

Mechanical air driers have been designed and proposed for fish drying. Any such drier would have to have a high turnover capacity per batch so as to keep the cost of drying low. As the capital investment would be high, the adoption of mechanical driers needs a change in the structure of production from the present cottage level to an industrial scale.

FISH MEAL AND OIL INDUSTRY

The term fish meal covers in our commerce and trade a wide range of products. The only common feature is that these are all dried and powdered products derived from the raw material fish. Even fish guano and inferior quality of fish meal suitable for use only as organic fertilizers are termed fish meal. Thus the fish meal of commerce would vary widely in quality and composition in accordance with the type of raw material and method of production. The products may, however, be deemed to fall into three main types:

1. Meals from dried fish: Local surpluses of small and miscellaneous fish sundried on the beach or on prepared ground and brined or salted fish which do not find remunerative market as dried fish. These are collected in centralised factories where they are further sundried, sieved to separate the smaller particles of sand and then pulverised.

2. Meals produced by indigenous batch-type wet-reduction procedure: Seasonal surpluses of oil-sardines are cooked in mild steel cauldrons, pressed in hand-operated screw presses, the press cake is sundried and milled. The press liquor is allowed to settle in tanks and the supernatant oil is collected. Quite a number of such units get active all over the Dakshina Kannada coast when there are glut landings of old-sardine.

3. Fish meals produced by continuous wet reduction: There are four continuous wet reduction plants in Dakshina Kannada and one in Uttara Kannada, producing fish meal and oil based on oil-sardines, with raw material input capacity in the range of 25–40 tonnes per 24 hr. These produce meal and oil of the best quality obtainable in the country.

Fish meal and oil production as a means of utilising fish that otherwise would go to waste, is based on the lowest disposal rates of surplus fish in order to be economically feasible. It is significant that two fish meal and oil plants installed in Kerala are not operating although that State accounts for 5/6 of the country's total landings of oil-sardines, this being due to

unworkable raw material prices. The same fate is potentially existant, specially during the coming decade, for the plants now active in Karnataka. The fortunes of this industry fluctuate with whether or not there are glut landings. It would be too unworkable to import any new fish meal and oil plant into Karnataka, especially when indigenous know-how for putting up plants is available.

There is one shark liver oil extraction unit working in Malpe. There is also a factory at Mukka which hydrogenerates sardine oil for use as fat soapmaking.

Fish meal and fish oil offer no problems in terms of marketability of the end products, there being short supply of both within the country.

CHITIN AND CHITOSAN

The various products experimentally prepared from prawn shells are: (1) fertilizer, (2) poultry feed, (3) prawn and fish feed, (4) protein extract, (5) broth, (6) bacteriological peptone, (7) cholesterol, and (8) chitin. Glucosamine and chitosan are two products derivable from chitin.

Although many potential applications for chitin and chitosan have been recognised, there does not seem to be an adequate basis on which to launch commercial ventures. The potential users should know where and how these products fit into their line and what qualities they could expect from these materials. Those who would produce chitin or chitosan do not know how to provide all information needed to promote their uses. The cost effectiveness of these products in their many potential applications has still to be established. Until we are able to undertake studies relating to actual applications of chitin and chitosan and develop the ability to demonstrate on-the-line usefulness of these materials, working out processes for producing these materials will serve little immediate purpose.

OTHER FISHERY BY-PRODUCTS

The scope for fishery by-products in Karnataka, other than those discussed above, is a matter for study and further development.

Fish Canning Industry in Karnataka—Past, Present and Future

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ABSTRACT

The present paper aims at discussing briefly the past performance, present status and future prospects of marine products canning industry in the State of Karnataka. In traning the trends during the past three decades of commercial fish canning, an attempt is made to analyse the main factors that are significant for the progress and development of this industry. Along with a factual presentation of the present status in Karnataka (vis-a-vis India and the world as a whole), the major hurdles and bottle-necks that obstruct the rapid expansion of this sector are discussed. New innovations applied to this method of preservation of fish and fishery products, in advanced countries are outlined with a view to consider the feasibility of their adoption by our industry. Some possible solutions to the technical, economic, fiscal and legal problems are also envisaged. A few attempts made by some agencies to improve the situation are mentioned. Against this background, the future prospects of commercial canning of seafoods in Karnataka are discussed. Certain conclusions that could be drawn are finally summerised.

INTRODUCTION

Canning has been one of the major methods of food preservation all the world over right since its discovery in the early 19th century. Canning of fish and fishery products has developed to such an extent that in recent years the industry utilises about 14% of the total world catch of 80 million metric tons of sea foods, or 20% of the quantity used for human consumption. However, there is much difference from country to country regarding the extent to which the seafood canning industry has progressed. Compared to the United States of America and Japan, India, even though ranking fairy high among the fish producing countries of the world, occupies a very insignificant position as a fish canning nation (Table 1). But, we look within the country and compare the relative status of each state, Karnataka with 1/20th of the Indian sea coast, stands second only to Kerala in the development of fish canning industry. This paper presents a brief review of the past performance, present status and future prospects of the said industry in our State. The discussion that follows includes

Table 1. Fish Production and Percentage Utilization for Canning of World and some Selected Countries

World/Country	Total Fish Produced (Metric Tonnes)	Per cent utilised for canning (Average of 5 years)
World Total (1984)	80,121,000	13.76
U. S. A.	4,741,000	21.06
Japan	11,800,000	6.92
India	2,840,000	0.23

some of the major problems faced by fish canning and possible solutions for the same.

HISTORICAL DEVELOPMENT

Sir, J. C. Drummond, speaking of the canning industry as a whole in 1949, remarked that "the great canning industry of the world today looks back over a history of a little more than a century, a century of brave enterprise, baffling problems, disheartening failures and brilliant achievement". The history of fish canning in Karnataka can also be said to have followed a parallel course, though over a much shorter period of less than thirty years, being subjected to similar fluctuations of fortune and passing through all the phases so accurately described.

The credit for the earliest attempts at canning fish and marketing fish based products in Karnataka would probably go to Sri B. M. Thingalaya of Mangalore, who started the Kaivarthaka Industrial Works at Hoige Bazar in the 1930's and produced and marketed canned fried fish and fish biscuits on a small scale. However, the pioneering of large scale commercial canning of fish in the state was successful mainly due to the efforts of Sri Madhwaraj of Malpe, who launched the Coronet Canning Company with the major objective of supplying canned fish and fish products to the Indian Armed Forces in the year 1958–59. There followed in the next decade and a half, a rapid expansion of the industry in the two coastal districts, mainly in Dakshina Kannada, and a number of canneries were set up, largely on account of the growing demand for canned prawns from the advanced countries of Europe and America. The starting of the Marine Products Processing Training centre with Japanese collaboration under the Colombo plan in 1963, offerering one year post graduate diploma course, became very helpful in providing technical knowhow and trained personnel qualified in canning and fish processing to man the factories in Karnataka as well as other States of the country. The centre later became (1969) the nucleus of the precent College of Fisheries under the University of Agricultural Sciences which continues the good work. Subsequently, the opening of the Export Inspection Agency's office and laboratory in Mangalore, brought with it the preshipment inspection facilities to close quarters. Similarly, when the Marine Products Export Development Authority started functioning at its Mangalore office (1980), canners and exporters could readily obtain the assistance of this organisation. All these developments contributed to the rapid expansion of the canning industry of Karnataka. The particulars of the various firms engaged in seafoods canning in the state at some time or other can be seen from Table 2 and Fig. 1.

However, after reaching its peak performance in 1973–74, unexpectedly, the industry in Karnataka (as well as the whole of India) experienced a sudden and spectacular fall due to several causes, the most important of which was perhaps the immediate failure of the shrimp export market. This debacle of the canned shrimp export trade had a disastrous effect on the fish canning industry all over the country. Several canners completely closed their operations and sold out their plants. Many more, changed over to packing fruits or soft drinks. Only those who had the tenacity and will to servive, continued processing even though at a much lower level of production, making use of Sardines and Mackerels in place of prawns. As canned shrimp export reached almost a negligible level, the surviving canners had to explore other markets, mostly internal for their alternate fish packs. With the introduction of purse seine fishing as a major

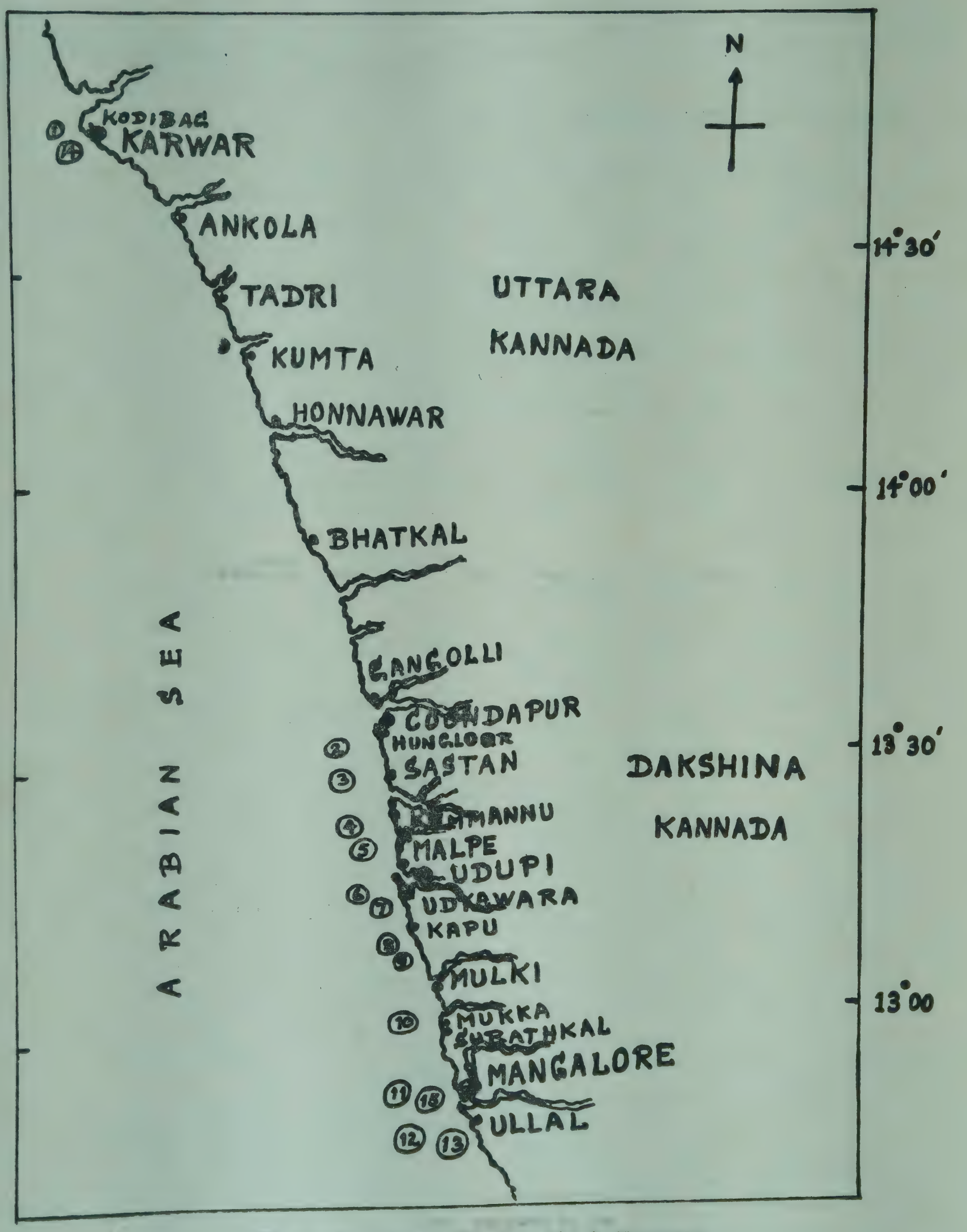

Fig. 1. Locations of Fish Canneries in Karnataka

Note: Numbers within circles refer to canning plants as listed in Table II.

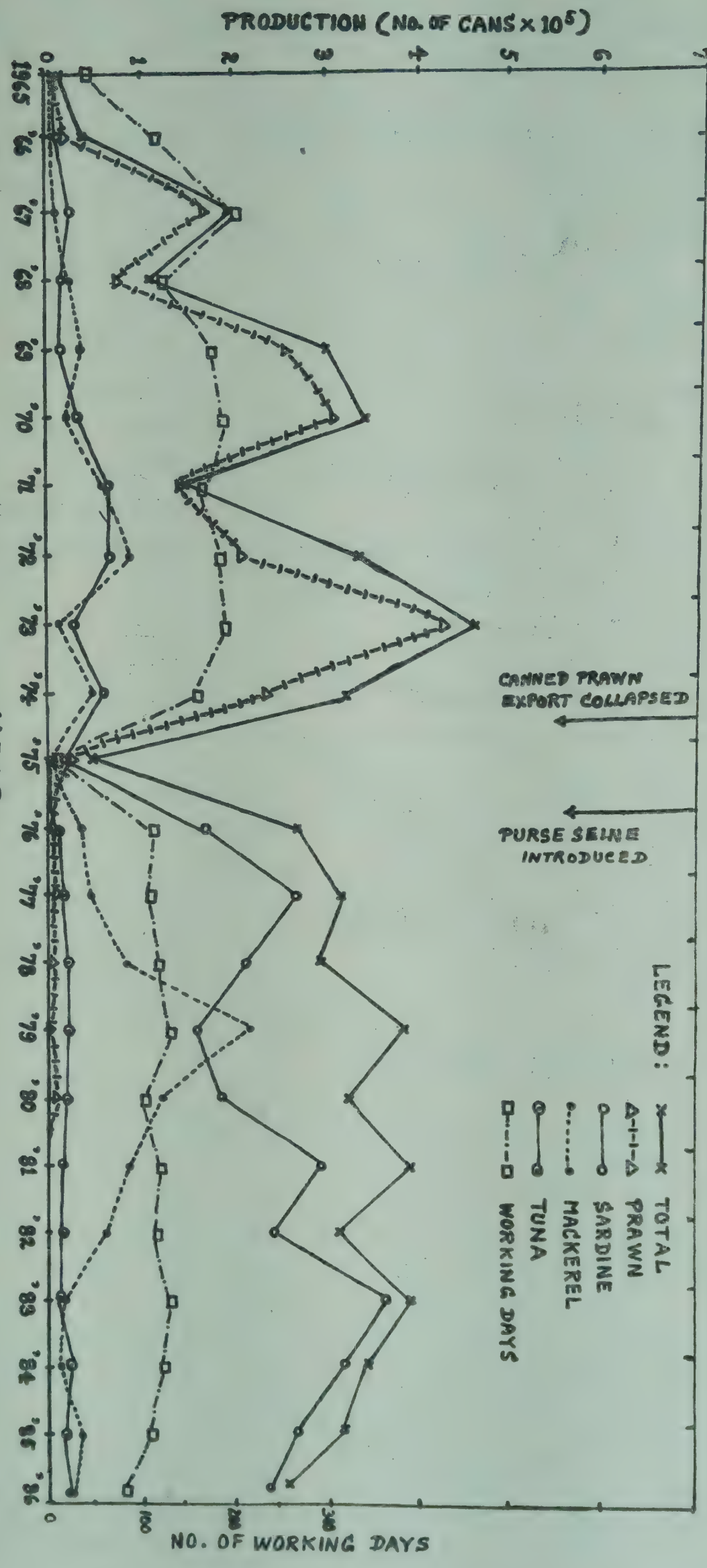

Fig. 2. Fluctuations in Canning of Seafoods in a Typical Cannery in Karnataka State (1965—1986)

Table 2. List of Fish Canners in Karnataka State, Past and Present

Sl. No.	Name of the firm	Place of operation	Currently functioning (+)
1.	N. K. Dt. Fish Marketing Federation Canning Plant	Kodibag, Karwar	—
2.	Mysore Canning Company	Hungloor, Coondapur	—
3.	St. Judes Canning Company	Sastan	—
4.	Kaivarthaka Industrial Works Canning Plant	Kemmannu	—
5.	Coronet Canning Company	Malpe	+
6.	Canara Seafood Packers	Udyawar	+
7.	Sowkar Canning Company	Udyawar	+
8.	Vijayalakshmi Canning Industries	Kaup	+
9.	Bharath Industrial and Canning Company	Kaup	—
10.	Madonna Canning Company	Mukka, Surathkal	+
11.	S. K. Dt. Fish Marketing Federation Canning Plant	Mulihithlu, Mangalore	—
12.	Canning Industries Cochin (CAICO) Canning Plant	Ullal	—
13.	Mulbery Aquatics Canning Plant	Ullal	—
14.	Food International, Ankola	Karwar	+
15.	Vikram Fisheries, Malpe	Mangalore	+

factor in raw material supply, the whole pattern of fish canning in Karnataka underwent a radical change, as in the other states. These changes in canned fish production can be visualised from Fig. 2. Changes in export pattern can be seen from Table 3.

PRESENT STATUS OF THE INDUSTRY

To recover from the shock sustained from the loss of the canned shrimp export trade and to read just to the changed conditions and stabilise, the fish canning industry of Karnataka took almost half a decade, that is from mid seventies to the beginning of the eighties. Some significant features of the present situation are presented in Table 4. It can be seen that only less than half the total number of fish canners mentioned earlier are operating at present. Even though some semblance of stability is apparent, the level of production is much lower than the optimum, often being between 20–30 per cent of the built-in capacity. The average number of shifts worked in a year is hundred or less, instead of the normally required 250 to 300. The industry uses only two or three kinds of fish, making less than half a dozen packes using very few sizes of containers and caters to a limited internal market. Thus it seems that there are no encouraging signs of a helathy development and expansion of seafoods canning in the state at present. This settling down to an almost uneconomic, non-remunerative and static level of the industry, at a time when we see active and rapid expansion in so many other industrial fields, not only in Karnataka but all over India, is a matter that requires a closer and more detailed examination and objective analysis.

FACTORS INFLUENCING DEVELOPMENT

The question 'what ails our fish canning industry?' can be answered if we carefully

Table 3. Change in the Pattern of Indian Canned Sea Foods Export after 1973 (value in 1000 Rs.)

Item	Year	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1.	Prawn (shrimp)	52,369	47,842	5,999	3,935	5,221	9,149	6,428	15,794	4,900	4,740	4,408	2,917
	(Per cent of Total Export)	(6.50)	(6.27)	(0.57)	(0.22)	(0.29)	(0.43)	(0.25)	(0.72)	(0.17)	(0.14)	(0.04)	(0.08)
2.	Fish	25.4	27.6	—	26.2	—	19.6	79.9	—	—	—	—	—
3.	Sardines	—	—	—	534.4	141.1	0.1	—	—	37.1	—	26.1	—
4.	Crab meat	384.3	509.5	105.5	1,450.1	3,143.9	1,940.7	2,934.9	2,895.1	2,895.0	2,504.2	24.1	—
5.	Clean meat	—	—	4.4	—	—	—	—	—	185.8	—	—	—
6.	Mussels	—	—	3.2	—	—	12.9	48.3	4.3	—	—	—	—
7.	Mackerels	—	—	1.7	—	—	—	—	—	—	—	—	—
8.	Tuna	—	—	—	—	349.1	219.7	15.1	223.5	373.0	—	—	24.7

Table 4 Present Status of Fish Canning Industry in Karnataka (1985–86)

Item		Particulars
1. Number of actively functioning canners	:	7
2. Built-in Production capacity of the above plants	:	50–60 thousand cans per shift
3. Capacity of fish intake (maximum)	:	50 tonnes per shift
4. Average rate of production	:	25–30% of capacity
5. Number of shifts worked per year	:	80–100
6. Kinds of fish packed	:	Sardines, Mackerels, Tuna
7. Containers used	:	No. 1 Tall, 1 lb Jam, 8 oz, Quarter Dingley
8. Markets	:	Mainly North East Indian States (Assam, Tripura, Nagaland, Mizoram, Arunachal Pradesh) and Sikkim and Bhutan. Small production in local cities.

analyse the factors that influence the development of fish canning, because the problems besetting the industry are related to one or more of these basic factors. As in any other field, a rapid expansion and progress of the seafood canning industry depends on (a) efficient and economic production and (b) favourable marketing. Economic production of canned fish implies a regular supply of good quality fish throughout the year at reasonable price, availability of suitable containers, plant, machineries, equipments, water, power, labour, transport facilities, ice, cartons, lables and other physical inputs. In addition, upto date technical knowhow and efficient management are also required. The importance of the necessary amounts of capital at moderate rate of interest, both for initial investment and operational purposes when needed, is released only by those who have direct experience of working in the uncertain conditions of the fishing and processing industries. Favourable marketing of canned fish products depends on the existence of a steady and growing demand for the goods, either within or outside the country. Successful marketing involves a good marketing strategy, based on a knowledge of potential areas, detailed survey, presence of compeitors, their strength and weakness. The dangers of having only a single limited or export market, have already been amply demonstrated in shrimp canning. A varied reliable and expanding market, especially withing the country, can alone sustain a growing fish canning industry. Development of such market through advertisement, publicity propaganda and incentives, is as important to seafoods canning industry as to cosmetics, soap, toothpaste or any other consumer goods industry. In addition to these, favourable laws governing taxes and duties on fish, containers and other inputs, as well as the finished goods, are also necessary.

MAJOR PROBLEMS

When we consider the present situation of low production level (underutilisation of capacity), high costs of input and limited marketing resulting in poor return to the canners, against the background of the above listed prerequisites of healthy expansion and rapid progress of fish canning industry in the state, certain significant facts become evident regarding the problems facing the industry. Though these are interrelated in many respects, they may be reviewed under the following major heads for convenience.

Raw materials for canning:

Perhaps the most important and serious difficulty experienced by our canners is the short and uneven supply of fish, which itself depends on the vagaries of our fishing. Even though Karnataka fishery comprises mainly of mackerels and sardines used by the canning industry and the introduction of purse sein has greatly improved the supply of those fishes, the high degree of fluctuation in landing, competition from fresh fish market, freezers and fish meal manufacturers, added to lack of chilled store and frozen storage facilities which could improve and even out the supply to canners, and the higher costs, continue to render the situation most unsatisfactory. Further, alternate materials such as clams, crabs, oysters, as well as other available fishes like seer, lactarius, lesser sardines, cat fish or tuna, are not being utilised by the canning industry to any great extent so far.

Lack of suitable containers:

Fish canning in India, as well as in Karnataka, find only a very few containers available for use. Two or three cylindrical and one rectangular tin plate cans, with a limited range of net capacity (106 g to 450 g), supplied by only one or two can makers, are insufficient to provide variety to consumers. Also, these are more expensive than in other countries, constituting 30 to 50 per cent of the product cost instead of the 12 to 20 per cent prevailing elsewhere. Even these are in short supply, very often when the canner is in urgent need. Tin cans of larger sizes for institutional packs, these of thinner plates costing less, externally lacquered, printed or lithographed cans, cans of aluminium, 'pull ring' type of cans for greater consumer appeal and convenience are not available to the fish canning industry. In fact, the part played by a variety of different containers in relation to fish canning, is not fully realised by us.

Lack of diversification:

Diversification in the fish canning industry can be achieved by several means such as, use of different raw materials, production of different types of packs from fish already in use, application of a variety of filling media, and also different containers. The Japanese fish canning industry, for example, has been successfully manufacturing and marketing more than hundred canned fishery products, compared to a dozen or less in India. This aspect has been stressed by many workers in the field, including one of the present authors, who have stressed the advantages of diversification.

Marketing effort:

Intensive efforts at developing existing and new markets, both within and outside the country, are lacking in the fish canning industry. Even though we see everyday a lot of sales propaganda through newspapers, radio, television and other media in connection with the promotion of a large number of consumer goods, there is practically no work being carried out in this direction by the seafood canners for their products. In spite of the extra expenditure involved such efforts are most likely to yield fruitful results in the long run.

Power, labour, capital and other requisits:

Other problems, perhaps of comparatively lesser importance but may often cause sufficient trouble in the industry, are those related to these factors. Irregular power supply due to intermittent power cuts during months of shortage of electrical power, combined with higher costs, may come in the way of regular production of a canner. Overall labour situation may not be unsatisfactory in the canning industry, but

non-availability of seasonal labour in localised parts may be a problem. Some canners may find it difficult to mobilise enough operational capital at short notice and may have to reduce purchases of fish, cans and other materials when available at attractive terms. Water supply generally, has not been a cause of trouble in coastal Karnataka. Managerial ability and technical knowhow have not been mentioned as lacking in the state fish canning sector.

FUTURE PROSPECTS

As already mentioned, the fish canning industry of Karnataka has stabilised itself at a much lower level than desirable, after recovering from the shock of the mid seventies. Further development and future prospects depend on how far and how fast the major problems are solved and the hurdles passed. Some suggestions for much needed action for encouraging and effecting progress in fish canning industry in the state may be mentioned here. These include:

1. Action to improve the raw material supply situation for the canning industry—such as greater efforts at deep seafishing which can provide a steady supply of tuna and tuna like fishes.

2. Use of as many different kinds of fish as possible as rawmaterial for canning.

3. Establishments of large cold storage to preserve excess raw material during peak seasons and make available to canners at reasonable price throughout the year.

4. Application of new innovations like, light tin cans, aluminium cans, collapsible pouches etc. as in other advanced countries. Use of new technology.

5. Diversification of fish canning and of canned fish markets.

6. Intensive and extensive marketing, effort both within and outside the country, such as holding exhibitions of products, conducting food fairs etc. for effective consumer education and sales promotion.

7. Arrangements to supply cans at short notice instead of carrying a huge inventry and blocking scarce funds as at present.

8. Forming a seafood canners association for more effective and concerted effort in all matters.

In a few of the areas some positive action has already been initiated. For example, a newly started commercial fishing company has seriously taken up deep sea fishing for high quality tuna and the catch is expected to be over 2000 metric tonnes per year, all of which can be used for canning. Utilisation of new species and diversification of canned seafood products is being given adequate attention at the Department of Fish Processing Technology of the College of Fisheries, Mangalore, where procedures have already been standardised for canning over 50 new packs based on marine materials like mackerels, sardines, little tuna (*Euthynnus affinis*), the giant cat fish (*Tachysurus thalassinus*), pink perch (*Nemipterus japanicus*), the white sardine (*Kowala coval*), clams (*Meretricx meretrix*, *Katalysia opima*), green mussel (*Mytilus viridis*) and the squids (*Lolige* spp.). Efforts are in progress for popularising modern, pull-ring type aluminium cans for fish at the Integrated Fisheries Project, Cochin, but large scale

adoption of these will depend upon the indigenous manufacture and supply of the containers to the fish canning industry. Feasibility study of using cheaper flexible pouches for fish packs is being carried out at the Central Institute of Fishery Technology, Cochin. However, popularisation of canned fish products on a large scale in the interior markets and overseas and intensive sales promotion effort requiring large initial investment, may require the assistance of Development Departments of the Government, and other organisations like the Marine Products Export Development Authority and the Fisheries Development Corporation.

CONCLUSION

It is evident from the foregoing discussion that the present status of the fish canning industry in Karnataka, though comparatively better than in the whole of India, is far from being satisfactory. It uses only 3 per cent of the fish landed in the State and is working at 20–25 per cent of installed capacity. If this position has to improve, there should be some significant breakthrough in some of the areas mentioned, especially fish and container supply position, introduction of new technology with diversification and intensive sales promotion. According to a survey of the Marine Products Export Development Authority (1985), projections for Karnataka during the next five years indicate an annual fish landing of over 2 lakh metric tonnes. If at least 10 per cent of this (i.e. 20,000 tonnes) can be used for canning, the industry would reach 75 to 90 per cent of its installed capacity utilisation. Regarding technical knowhow and qualified personnel, there seems to be no dirth in the State. Efforts at diversification and new product development also seem to be satisfactory. Therefore, with necessary assistance from the Government, M.P.E.D.A. and related organisations for sales promotion and cooperation from the can making industry for the supply of containers, it seems reasonable to visualise a target of utilising 10 per cent of the State fish landings (equal to world average) and working at near full capacity in the fish canning industry in Karnataka, in the near future.

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A study of the yield of shark fin rays from commercial sample of shark fins

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ABSTRACT

A study of the yield of fin rays from different types of commercially available shark fins, is carried out. After comparing two methods for obtaining the 'needles', one of the methods was followed as being more convenient. Fin rays obtained by this method from different parts of important species of shark available in Karnataka State, are described in the reference to their colour and quality.

INTRODUCTION

Among the various parts of shark utilized, the fins form a very important commercial commodity. From India every year about 2,11,747 kgs of shark fins valued at Rs. 2,10,32,651/–. are exported. Hongkong is one of the principal market for shark fins exported from India. Other than Hongkong, shark fins are also exported to Singapore and the United Kingdom.

Elasmobranches consisting of sharks, skates and rays, form about 4 to 5% of total marine landings in India. Though fins from many species are exported, only the fins of a few species like *Rhychobatus djiddensis Scoliondon walbheensi*, *Carcharhinus melanopterus* and *Zygaena malleus*, fetch good prices.

There are many methods of cutting the fins of sharks. The three common methods are (1) crude cut (2) straight cut and (3) half-moon cut. The traders' main interest is in the quality and quantity of fin needles (Edward, 1983) and hence they prefer half-moon cut pectoral and dorsal fins. However, in Indian market, straight cut fins are common.

In the importing countries the shark fins are processed and marketed either as processed fins or as prepared fins. The processed fins are fins with skin off but otherwise retaining their shape, whereas prepared fins are nothing but ready to use fin needles.

MATERIALS AND METHODS

In the present study two different procedures were adopted for the extraction of fin rays. One method is based on the extraction of fin rays by soaking the fins in 10% (v/v) acetic acid as described by Nair and Madhavan (1974) and in the other the fin rays were extracted by a process described by Edward (1983). The quality of fin rays thus extracted by the two methods were judged by giving the fin rays to the local Chinese restaurants and taking their opinion.

During the experiments it was found that the method of Nair and Madhavan (1974) for the extraction of fin rays was time consuming. Moreover, in this process, after the removal of the calcareous shagreen layer, the fins were again soaked in acid solution during which the fin needles preferentially swelled and the tissues surrounding the fin

Table 1. Yield of fin rays from different varieties of shark fins

Species	Variety	Fin position	Dried fins Length (cm)	Dried fins Wt (gm)	Processed fins Wt (gm)	Yield % from dried to processed fin	Dried rays Wt (gm)	Yield % dry fins to fin rays
	Black (Hammer head)	Dorsal	34.0	215	76.5	35.58	28.40	13.2
		Dorsal	23.0	88	39.5	44.89	16.45	18.7
		Pectoral	27.5	124	47.0	37.90	25.85	20.8
		Pectoral	26.0	115	37.0	32.17	14.60	12.7
	Black	Dorsal	23.5	84.0	13.0	15.48	7.0	8.3
		Pectoral	27.0	106.0	11.5	10.85	10.5	9.9
		Pectoral	27.0	115.0	13.9	12.09	11.9	10.3
	Black (Black Tip)	Pectoral	14.0	27.0	12.4	45.92	7.4	27.41
		Pectoral	13.5	23.0	11.5	50.0	7.3	31.74
		Pectoral	12.0	13.5	7.3	54.07	4.4	32.59
		Pectoral	11.5	12.0	5.9	48.17	3.5	29.17
		Pectoral	13.0	17.0	8.0	47.06	4.4	25.88
	Black (Hammer head)	Dorsal	24.5	97.0	25.3	26.08	9.0	9.28
		Pectoral	23.5	70.0	30.2	43.12	11.1	15.86
		Pectoral	23.0	61.0	22.5	36.88	8.4	13.77
	Blue (Laccadive variety)	Pectoral	26.5	40.0	13.9	34.75	5.3	13.20
		Pectoral	25.5	46.0	11.5	25.0	4.4	9.60
		Dorsal	18.0	49.0	13.0	26.53	6.4	13.10
	White	Pectoral	18.0	43.0	19.0	44.18	8.05	18.7
		Pectoral	15.5	24.0	11.5	47.92	5.32	22.2
		Caudal (full)	19.5	35.0	14.0	40.0	6.16	17.6
			12.5					

needles were not affected. Hence the extraction of fin rays became difficult. Even though the quality of fin needles were acceptable in both the cases, for all further experiments the fin needles were extracted by the method described by Edward (1983).

Straight cut dry shark fins of varying size grade of black and white varieties were selected for the study. Only the lower lobe of the caudal fins were used, as the upper lobes contain little or no fin rays. In the case of white variety both the lobes were used. In the black variety, fins of different sharks such as black tip, blue and hammer head were used. Before starting the experiment the length of the dry fins were measured from the tip to the anterior corner (ISI–1967). Also the weight of all the fins were noted down.

RESULTS AND DISCUSSION

The length and weight of the fins, the weight of processed fins and prepared fins for each variety and their yield percentages are given in the table. As can be seen from the table the yield percentages of fin needles was the highest from pectoral fins of black tip and ranged from 26 to 32.59%. This was followed by white, hammer head, blue* and the least yield was from the black variety.

The yield percentage from dried fins to processed fins was lowest in black variety and highest for pectoral fins of black tip variety. The difference noticed in the yield percentages of these two varieties of hammer head shark may be because of species difference.

With regard to the colour of the fin needles produced, the white variety gave a transperent, very light ocean coloured needles, whereas the blue variety gave dark coloured fin rays with a bluish tinge. All other varieties gave fin rays with creamy yellow colour. Thick fin needles were more yellowish in colour whereas, thinner and smaller fin needles were lighter in colour and attractive appearance.

This study suggests further scope for more research work in this field. Studies are to be conducted for each of the commercially available species of different size grades and the quality and yield of fin needles are to be assessed.

*As called by the local traders.

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A Review on the Potential uses of Chitin and Chitosan

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ABSTRACT

Chitin is one of the most abundant natural polymers present in the exoskeleton of crustacea. It is the sole structural material responsible for their shape and rigidity. Shrimp processing industry turns out a large volume of this valuable material in the form of head and body peelings, every year. Though abundant in nature, this material has not received proper attention from scientists and technologists until recently. During recent years a renewed awareness is being shown by scientists from different parts of the world on the study of the properties and uses of chitin. Many potential applications of chitin and its derivatives, particularly chitosan are of great industrial importance.

This review article reports a summary of the literature on the occurrence, abundance, methods of isolation of chitin and the process for its conversion to chitosan. Information on their applications in various fields namely, paper, flocculation, chromatography, pharmaceuticals, cosmetics and food, is also presented briefly.

RESOURCES

Using specific and qualitative enzymatic identification procedure the polysaccaride chitin has been found present in a wide range of animal species (Jeuniaux, 1977). It is the second most abundant organic compound on the earth and fungi constitute its main source. In fungi it is present as the principal fibrillar structural material and is responsible for the rigidity and shape of the cell wall. The only major class of fungi which lack chitin are the Schizomycetes, Myxomycetes and Trichomycetes. Zygomycetes contain both chitin and chitosan (Ruief–Herrera, 1977).

In view of the expansion of the use of chitin and chitosan, Allen *et al.* (1977) have reported a critical survey of the possible sources of chitin. Attention was focused on chitin and chitosan yielding crustacea, insects, mollusca and thalophyta, which could either be harvested from the natural environment, artificially cultured or derived from existing waste streams. It is concluded that in the immediate future the principal source of chitin will remain shrimp and crab waste. Cultured fungi capable of synthesising chitin alone or in association with chitosan will probably assume the major supply role thereafter although the rearing of insects as a chitin source cannot be unequivocally ruled out. In the longer term Antarctic Krill or Californian red crab may become important supplemental chitin sources. Squid and diatoms can only be regarded as sources of small quantities of high quality chitin.

Chitin is the most important organic constituent of the skeletal material of invertebrates. It is found in anthropodes, annelids and molluscs. Invertebrates utilise the tough resilient properties of chitin as a body armour and a skeletal support. Besides crustaceans and mollusks marine benthic animals are also rich sources of chitin.

Despite their small size, bryozoan and hydrozoan colonies yield a large biomass with relatively substantial amounts of chitin, though not exploited at present (Jeuniaux, 1977). Although it is widely distributed among the lower animals its only economical source at present is crustaceans which are gathered on a large scale for food use. Modern freezing and canning operations with shrimp, lobsters and crabs have resulted in the availablility of substantial quantities of crustacean waste materials as head and body peelings at the processing sites.

The phenomenal increase in the processing of prawns in India turns out every year huge quantities of this important fishery waste containing about 10% (dry basis) chitin (Madhavan & Ramachandran Nair, 1974). Squilla (*Oratosquilla nepa*) known by the local names 'Chelly' 'Puchee' and 'Peychemeen' abundantly available along the maritime coast of India can also form a rich source of chitin. In the absence of any commercial fishing for squilla its abundance cannot be correctly estimated and is generally believed to be almost equal to that of prawns (Madhavan & Ramachandran Nair, 1975). Moorjani *et al.* (1977) have reported the annual availability of squilla as 50,000 tons.

Structure and Properties

Chitin is a high molecular weight, linear polymer of anhydro-N-acetyl-D-glucosamine (N-acetyl-2-amino-2 deoxy-D-glucose). As in cellulose, the monomer units are linked by B-(1-4) bonds. In the natural state chitin is insoluble in water and organic solvents. Its regenerated films are tough, clear, flexible and like natural chitin, insoluble in water and organic solvents. Hydrolysis under drastic conditions with concentrated acids yields relatively pure amino sugar D-glucosamine. Deacetylation with sodium hydroxide yields the free base, 2-amino-2-deoxy-D-glucoglycan, commonly known as chitosan, which is still insoluble in water and gives water soluble cationic colloid on addition of acid forming the corresponding salt (Mcneely, 1959). Chitin occurs in three polymorphic forms which differ in the arrangement of the molecular chains within the crystal cell. Typical X-ray spectra shows that α-chitin is the tightly compacted, most crystalline polymorphic form where the chains are arranged in an antiparallel fashion; β-chitin is the form where the chains are parallel and γ-chitin is the form where two chains are "up" to every one "down". By far the most abundant form is the α-chitin present in arthropod cuticles and certain fungi. γ-chitin can be transformed into α-chitin by treating it with lithium thiocyanate. The three forms of chitin have been found in different parts of the same organism, namely, in the squid Loligo, whose beak contains α-chitin, pen contains β-chitin and stomach lining contains γ-chitin. This indicates that the three forms are relevant to the different functions and not to animal grouping (Muzzarelli, 1977).

Kandaswamy (1978) reported that there exist chemical differences between α and β chitin in addition to difference in crystalline forms. Presence of γ-chitin in peritrophic membrane of tunicate was reported by Gowri *et al.* (1982). The γ-chitin could be distinguished from the other two types of chitin based on their acetyl contents.

Chitosan in acidic medium develops a violet or reddish colour with iodine. This colour reaction known as chitosan test is made use of in the identification of chitin. Sundara Rajulu (1982) studied the comparative merits and demerits of this with the enzymatic methods and reported

that enzymatic test is more reliable than the conventional chitosan test.

Hexafluoroisopropanol and hexafluoro acetone sesqui-hydrate are solvents for chitin. It has been found that chloro alcohols (some of them also known as clorhydrins) in conjunction with aqueous solutions of mineral acids or with certain organic acids are effective systems for dissolving chitin. The choice among these solvents is always a compromise among such aspects as rate of solution, rate of chitin degradation, viscosity of the acid and viscosity of the resulting chitin solution (Muzzarelli, 1977). Dimethyl acetamide containing 5% lithium chloride is one of the novel chitin solvent (Rutherford & Austin, 1977). This has facilitated the solution, purification identification and characterisation of chitin. Muzzarelli (1977) in his book on chitin has described the sterio chemistry and physical characterisation of chitin in detail.

Both chitin and chitosan are hydrolysed in presence of specific enzymes grouped as chitinase and chitosanase. Chitinases are widely distributed enzymes synthesized by bacteria, fungi and digestive glands of animals whose diet includes chitin. It is present in the pancreas or gastric mucosa of the frog *Rana temporaria temporaria L.* Fowl particularly poultry, possess considerable recoverable chitinolytic activity in their digestive tract. Endo-B-N-acetyl muramidases or lysozymes present in maniatin tissues, insects, plants, birds and micro organisms also have chitinolytic activity. A new class of enzymes, chitosanases, active in hydrolysing chotosan, has been reported by Monaghan *et al.* (1973) from 25 fungal and 15 bacterial isolates from among 200 microorganisms studied. Kimura (1966) found that calcium, lead and mercury ions inhibit chitinase activity whilst manganese, iron, tin and zinc (as chlorides) enhance it.

Production

Since the main source of chitin is crustacean shells, the raw material for its commercial production comes from fish processing Industry. The prawn wastes comprising the head and body peeling of shrimps contain high amounts of moisture followed by minerals and protein apart from chitin and small amounts of pigments. Being highly perishable, care should be taken for collection and storage of the raw material.

A process is described for the preparation of chitin from prawn waste by Madhavan and Ramachandran Nair (1974). The process involves extraction of protein using 0.5% NaOH bleaching the protein free mass with bleach liquor containing 0.3 to 0.5% available chlorine followed by demineralisation with 1.25 N HCl in the cold and deacetylation using 1:1 (W/W) sodium hydroxide solution at 100°C for 2 hours. Ramachandran Nair (1974) has also described a process for deacetylation of chitin at room temperature and comparative data on viscosity of chitosan produced by deacetylation at 28-30°C and at 100°C. The process was modified to suit to squilla and has been reported by Madhavan and Ramachandran Nair (1975). Radhakrishnan and Prabhu have described a process for preparation of chitin from prawn waste and conversion to chitosan using alcoholic potash. Results of pilot plant study on the production of chitosan giving exhaustive information on raw material, process equipment design, process data and economics were presented in the form of a report by the Central Institute of Fisheries Technology, Cochin (Anon. 1983). A brief description of the process, plant and machinery required for the production of chitin and chitosan from prawn waste is given by Abuthathir Ali *et al.* (1981). The requirements for a small scale production unit for chitosan with all tech-

nical information on process, plant and machinery and economics are presented as a report by Central Institute of Fisheries Technology, Cochin (Anon. 1985).

Factors of economic and functional importance in location design and operations of a manufacturing facility to produce chitin, chitosan, protein and possibly other products from crustacean waste are discussed (Johnson and Peniston, 1977). Problems of shell supply, chemical and energy requirement, manufacturing cost, physical characteristics of shells from various crustacean species, quality control requirements, disposal of effluents, byproduct recovery, estimate for the plant and possible price range of the product and profitability are projected. Basic technological and techical conditions for the commercial utilization of krill waste for making chitin and chitosan and their yield and properties and economic factors have been described (Brezeski, 1982). The different parameters on the production of chitin and chitosan and their influence on the quality of chitosan, practical assessment of supply and demand are discussed by many workers from different parts of the world (Johnson and Peniston, 1977; Bough *et al.* 1977; 1978, 1978A, 1978B; Murray and Hattis, 1977; Moorjani. 1977; Anderson *et al.* 1977; Wu and Bough, 1977; Muzzarelli, 1977).

Applications of chitin/chitosan

Scientific interest on chitin started in the year 1811 when Henri Braconnot discovered it by isolating a cellulosic substance during the course of his work with mushrooms which was then named as "fungine". The nformation gathered remained unutilized until about 50 years ago when new awareness generated on the potential applications of this polymer. Now because of the renewed interest, owing to the abundance of this natural material polymer and the commercial availability of the raw material from fish processing industry as waste, scientists and technologists from various parts of the world are bringing out newer areas of applications of chitin and its derivative chitosan. The three International Conferences (Anon, 1977, 1982, 1985) held on the subject in recent times gave oppotunity for experts and researchers to meet together and share their experience and to throw new light on the subject. The applications of chitin/chitosan so far known can be broadly classified under the following heads,

(1) Coagulant
(2) Chromatography
(3) Textiles
(4) Paper
(5) Photography
(6) Medical
(7) Adhesives and coating
(8) Agriculture
(9) Food

Coagulant

The property of long molecules of dissolved chitosan to wrap the solid particles suspended in liquids and to bring them together and agglomerate can be made use of in utilizing it as a coagulant aid. It can remove transition metal, vegetable matter and proteins. Chitosan has been shown to be effective for reduction of suspended solids in processing wastes from vegetables, activated sludge and in the clarification of beverages.

Peniston and Johnson (1970) studied the comparative efficiency of chitosan in settling montmorillonite as well as kaolite clay suspensions with separan. They also experimented on the settling power of chitosan

with various degrees of deamination to note the effect of nitrogen content and acetyl content on the coagulating ability of the polymer. It was shown that high nitrogen content and low deacetylation samples gave best results and concluded that partially deacetylated chitin can find use in treatment of waste water from mining operations, removal of tannin and polyphenolic materials from industrial wastes. Use of chitosan in removing suspended solids from processing wastes from vegetable, poultry and egg breaking plants was reported by Bough (1975) and Bough and Landez (1977). Bough (1976) also found it useful for the clarification of wastes from slaughter houses. The optimum concentration of chitosan for clarification was demonstrated as 30–40 mg $\times 1^{-1}$ after testing on a pilot scale. Investigations of Zall *et al.* (1976) showed that clam wash water was not amenable to coagulation by chitosan, alum and ferirc chloride. Fujita (1972) could obtain a completely supernatant liquid from fish solution after centrifugation by adding 0.5% chitosan solution in 0.3% acetic acid. Similar results were reported with soybean milk, skim milk and rice fermentation. Suzuki and Hayakawa (1976) could obtain a solid capture of 98% by the addition of 0.5 to 0.8% chitosan in sludge dewatering whilst it was only 61% without the use of the polymer. Bough *et al.* (1978A, 1978B) examined the influence of manufacturing variables of chitosan on coagulation and found that effectiveness was inversely proportional to molecular weight. The use of chitosan for coagulation of protein containing activated sludge at brewery and vegetable cannery waste was reported by Mcwhorter *et al.* (1976). Chitosan being +vely charged it is very effective to agglomerate the commonly –vely charged sludge particles.

Prabhu *et al.* (1976) compared the efficiency of chitosan with potash alum in clarifying contaminated water and reported chitosan as advantageous owing to its added property of coagulating and sedimenting the bacteria along with other suspended particles. Chitosan was found to be very efficient in the in-process flocculation in zinc and titanium manufacturing process (unpublished).

Nigam *et al.* (1980) found that 0.05 g/l of chitosan could flocculate mass outdoor cultures of the green alga, *Scenedesmus acutus* with 6.3 times less energy input compared to the use of desired centrifugal separator. Chitosan could flocculate dilute oil/water emulsions of soybean oil, typical of waste water from edible fat industry. The optimum floc formation depended on structure and charge density of the polyelectrolyte, emulsifier concentration, alkyl chain length and ionic strength. Chitosan produced the strongest and largest flocs with a smaller dose than the two other cationic polyelectrolytes (Zetag 92 and Polymin SN) tried. Effectiveness of Flonac, a chitin-chitosan derived polymer in sludge dewatering and toxicity and decomposition properties of Florac in soil are reported by Takashi Asano *et al.* (1977). Kurita water Industries Ltd., Japan (1984) has patented a process for sludge dewatering using chitosan.

Chromatography

Because of the presence of the amino and hydroxyl group that can act as electron donors towards transition metals ions and interact with organic substances like protein, chitin and chitosan are of great value for chromatographic supports. Thus several fields of chromatography are open to application of chitin, chitosan and their derivatives: ion exchange chromatography, chelation chromatography, high pressure liquid chromatography, gel-chromatography and thin layer chromatography.

Townsley (1961) anticipated that chitin can be used for nucleic acid chromatography, Nagasava *et al.* (1970, 1971) have used chitosan formate layer for the chromatography of nucleic acid. Muzzarelli reported the applicability of powdered chitin, isolated from king crab shell in thin layer chromatography. The ability of the chitin layer to separate mixtures of either phenols, amino acids, nucleic acid and derivatives or inorganic ion (Cu group) was almost equal or superior to that of crystalline cellulose silica gel and polyamide layers. Takeda and Tomida (1972) reported the use of chitin powder as a chromatographic support in thin layer chromatography for the separation of nucleic acid derivatives. Higher Rf were reported for chitin thin layers than for cellulose layers. Takeda and Tomida (1969A) used chitin in thin layer chromatography for the separation of amino acids. Chitin is superior to silica gel and polyamide for thin layer chromatography separation of some phenols. Muzzarelli and Rochitti (1973) have proposed a new method for the determinations of molybdenium in sea water based on the collection on chitosan columns followed by determination by atomic absorption. The same method can be used for the determination of vanadium in sea water.

Chitin can be used as a support for affinity chromatography of homogenates from human tissues. While the lysozyme is retained in the column, other proteins flow through and traces of them are washed out with distilled water. Chitin was used as a specific adsorbant for lysozyme by Kravchencko and Kuznetsov (1976). Imoto and Yagishita (1973) used chitin coated cellulose columns for adsorption of lysozyme. Cherkasov and Kravchenko (1970) Jensen and Kleppe (1972) have also reported the efficiency of chitin columns for the separation of lysozyme.

The property of chelating metals on chitosan is of great importance when considered in relation to environmental pollution. Waste waters and industrial effluents containing toxic or radio active metals can be adsorbed on chitosan. The resistance of chitin and chitosan to gamma radiation and its ability to adsorb metals open a new hope for the removal of radio active solutes. The chromatography of such solutes on chitosan was reported by Muzzarelli and Tubertini (1972). Muzzarelli and his co-workers made significant contributions in the study of the chelating property of chitosan on radio isotops (Muzzarelli *et al.* 1972; Muzzarelli, 1970). It was shown that Titanium, Zoirconium and hafnium ions are very efficiently collected on chitosan. Similarly miobium and ruthenium are also collected by chitin and chitosan. Cesium could not be collected on chitosan as it is an alkali metal. Muzzarelli *et al.* (1972) performed the separation of Cs^{137} from Ru^{106}, Zr^{95}, Nb^{95} and Ce^{144} atter oxidative treatment on chitosan column.

Muzzarelli and Isolati (1971) used chitosan for removal of mercury from industrial waters. The metal binding property of chitosan prepared under different temperature conditions were studied by Madhavan and Ramachandran Nair (1977). They reported the capacity of chitosan for binding different metal ions (Cu^{++}, Cr^{++}, Ni^{++}, Zn^{++}, Fe^{+++} and Mn^{++}) from their salt solutions. They also reported that the viscosity characteristics of chitosan did not affect the chelating properties of chitosan towards metal ions. Muzzarelli (1977) while studying the adsorption of mercury on chitosan reported that longer, narrower columns gave increased capacity for adsorption. He also found that complete elution of mercury was possible with 10 mM Potassium iodide solution whereas organic complexing agents were not effective for elution of mercury from chitosan columns.

Separation of manganese and ferrous ions from nickel and copper on chitosan was reported by Muzzarelli (1974) . The metal binding propeı ty of Kytex H (Chitin chitosan derived polymer) was reported by Hauer (1977) as comparable with other chelating resins. Masri and Randall (1977) reported the effectiveness of chitosan in batches and column flow operations, for the treatment of actual waste streams to remove toxic metals. Recovery of Uranium by chitin phosphate and chitosan phosphate is reported by Sakaguchi and Nakajima (1979). The chelating ability of chitinous materials from *Aspergillus niger*, *streptomyces*, *Mucor rouxii*, *Phycomyces blakesleeanus* and *Choanephora cucurbitarium*, on 9 metals were studied by Muzzarelli and Tamfani (1977). Ramachandran Nair and Madhavan (1982), studied the metal binding property of chitosan prepared from crab, prawn, squid and squilla and their comparative efficiency in metal adsorption. They also (1982) reported the different parameters affecting the rate and ability of collecting Mercury from solution (1983). The possibility of complete removal of mercury from water was also reported (Ramachandran Nair and Madhavan, 1984) and they found that particle size and time of treatment have significant effect. The concentration of mercury in solution is more influential on the removal of it by chitosan. Davies *et al.* (1980) report that chitosan/chitin mixture treatment on contaminated drinking water for removal of arsenic can reduce its level though not to the extent of commeı cial ion exchange resins. The role of chitin in the transport of metals to the ocean was discussed by Subramanian (1977). Sakaguchi *et al.* (1979) on investigation reported that chitin and chitosan could not absorb uranium from sea water whilst chitin phosphate and chitosan phosphate adsorbed large amounts.

Later, Allen and Co-workers made exhaustive studies on the use of chitosan in improving the properties of paper.

Polymers can inter-act with fibres and increase Van der waals forces, hydrogen bonding ionic inter-actions and covalent bond formation. Negative sites can be introduced on to the fibre using suitable additives called modifiers to give improve ment in the physical properties of the resulting fibre sheet. The preferred polymer to enhance paper strength should be linear, to allow complete accessibility to its functional groups, film forming and of high molecular weight, for good cohesive strength and for the ability to spare inter-fibre distances; polycationic for ionic bond formation and in addition it should be capable of forming hydrogen bonds with nonionic areas of the fibre surface. Chitin ought to have all these properties. But to bond readily the area of contact is to be increased by mechanical beating. Since beating is inefficient for chitin, a modification to chitosan by deacetylation is required to perform this task. Exposed free amino groups in chitosan are readily available for fibre chitosan bonding (Muzzarelli, 1977).

Allen, *et al.* (1972, 1975, 1976) have reported the effectiveness of chitosan into the cellulose in relation to the method of incorporation, viz. equilibrium adsorption, precipitation, spray application, chitosan composites and films. Du pont de Nemours (1936) reported that chitosan sizing improved the wet and dry bursting strength, water resistance of paper and give good surface for writing and printing. Merril (1936) showed that chitosan impregnated paper by acylation using acetic anhydride gave improved oil resistance to paper. Srinivasa Gopal, *et al.* (1981) found that chitosan treated craft paper is a good substitute for glassine paper as a carryhome pack for butter. This coating improves the

bursting strength, puncture resistance, water vapour transmission ratio, water proofness, tensile strength and grease resistance. Much better physical properties were also found for corrugated boards made of chitosan treated kraft paper. They also reported that duplex board cartons made of treated craft paper were excellent for packing fish particularly for freezing fish in place of wax coated ones, as the water frozen in the carton did not stick to the board.

Encouraging results are also reported using chitin as an additive to improve the electrical qualities in capacitor tissue (Anon, 1973), Kobayashi, *et al.* (1982) applied aqueous solution of chitosan acetate on Japanese paper "hosho paper" to improve the surface strength, softness and permeability. They also prepared a whole chitin paper with considerable strength using chitin fibre as a component fibre with the aid of N-substituted chitin fibres as binders. Bulky N-alkyl derivatives of chitin were found to be effective binders.

Junjo Noguchin, *et al.* (1977) prepared chitin films and fibres from chitin viscose and from a solution of chitin formic acid containing 8% dichloro-acetic acid. Chitin viscose was blendable with cellulose viscose. Cellulose fibre containing 3% chitin had a ramie-like feeling and a high dyeability. So also the properties of viscose-rayon fibre were improved. They also prepared diacetyl chitin and acetyl chitin fibres and films with added flexibility with the increment of acetylation. Tokura and Nishi (1982) prepared alkylchitins with various alkyl halides and the properties of the fibres prepared out of it were reported. The affinity to water or formic acid was remarkably enhanced and it was found to correspond with the chain length and bulkiness of the alkyl group.

Adhesives and coatings

Rigby (1936) reported that medium viscosity chitosan acetate when coated on one surface each of two sheets of paper could be joined together by their coated surface. Sadov and Markova (1954) showed that chitosan acetate solution could be used for sizing to increase the wear resistance.

Deacetylated chitin adheres well with non-conducting surfaces such as paper, rayon, cellophane, wood, leather, rubber and glass but not to metallic surfaces. These bonds are relatively water resistant, their resistance can be increased by incorporating formaldehyde in the adhesive or by heating the dried film at 100–150°C for a short time Mcneely (1959). Because of this property chitin is present in many well-known natural systems having property of adhesion. Otness and Mdcalf (1972) and Holland and Walker (1975) confirmed the presence of chitin in barnacle cement. Barat and Scaria (1962) reported that the eggs of hog lice were attached to bristles by a substance containing chitin.

Heat dehydrates the chitosan salt of certain organic acids by producing amides which are insoluble in water and acids. Chitosan dispersed in a sodium silicate solution forms a more water resistant joint than obtained with silica alone (Muzzarelli, 1977). Du pont de Nemours and Co. (1936) patented a process for making safety glasses, plywood, laminated paper, wood veneer paper and furniture. They also reported that asbestos treated with chitosan possessed better repellance to water and organic materials and also improved the wet and dry strength. They also patented a process for stiffening unsized straw-hat bodies, to prepare molding powders. Patterson (1938) suggested the use in priming coating of plaster surfaces. Jones (1954) reported its

use as a thickner in adhesives and drilling muds.

Chitosan is an effective sealer and primer for wood, asbestos, boards, paper, plastics, brick and tile and once coated it decreases or prevents penetration of contaminants and prolongs unsoiled appearance. Yamashita (1975) granulated fertilizer composition by spraying with 0.5% chitosan solution. Moshy (1969) found chitosan as quite suitable as an adhesive and film forming coating in tubacco sheet production. Babu, *et al.* (1975) found chitosan in combination with wattle bark useful as a filling material for poor quality leather to produce smooth, tight and full leather. The researches carried out at the Central Institute of Fisheries Technology, Cochin, had shown that chitosan coating on fruits (Mango and Banana) prolonged the ripening period (under pubication).

Textiles

The chelating ability, adhesive property and ionic bond forming characteristic when put together, can find promising and potential application for chitosan in textiles. The possibility of making chitin fibres either alone or in combination with cellulose have already been described by Noguchi, *et al.* (1973, 1978), Tokura and Nishi (1982), Kobayashi, *et al.* (1982). Since chitin viscose blends readily with cellulose and gives the viscos rayon the ramie-like properties, chitin viscose can be better used as an additive to cellulose viscose. Itaya (1976) (1976) spun a blend of polyvinyl alcohol and chitosan acetate.

Fabrics sized with chitosan salts were found to have greater stiffness and improved dye uptake, added lustre, and improved laundering resistance. The sizing with chitosan is permanent because it is precipitated over the fabric and the coating formed is insoluble in water. Fabrics can be laminated to each other or to paper, using chitosan. The use of chitosan in making non-woven fabrics of the resin bonded type was patented by Dabrowski (1976). Chitosan coated glass fabric offers permanent reactive sites on glass for adsorption of dyes of a wide variety and makes possible the dyeing of glass fabrics. Mody (1975) has proposed the use of chitosan in 1% acetic acid for improved and simplified dyeing of polyester and cotton fibres. Fabrics printed with chitosan when passed through reactive dye bath gives a two tone effect because of the higher dye uptake in the chitosan printed area. Masri, *et al.* (1977) reported that interfacial deposition of cross linked chitosan on woven wool fabric imparted laundering—shrinkage control.

Medical

Chitin and chitosan have been of great help in the past for the progress of medical and biochemical knowledge. Chitin oligomers were used to study the characteristics of lysosyme, which is a very important enzyme present in the human body fluids.

Chitin, chitosan and partially depolymerised chitin were found to be higher in wound healing activity than the standard acid-pepsin digested cartilage preparation. Balassa and Prudan (1977) reported that chitin/chitosan can accelerate healing of both slow healing and non-healing wounds (items). Unitika Ltd., Japan (1984) has patented a process for the production of absorbable surgical sutures from chitosan. Immunoadjuant effect of chitosan has been reported by Suzuki, *et al.* (1982). Hamner, *et al.* (1982) have reported the preparation of products similar to heparin having thrombo resistant properties. Muzzarelli (1984) has patented the method of prepara-

tion of a heparin like substance and anti-blood compatible polymers from chitin and chitosan. The use of chitin/chitosan injections for staphylococcus infection was patented by Suzuki (1984).

The dissolution properties of poorly soluble drugs can be enhanced by the use of chitin and chitosan (Sawayanagi, *et al.* 1982), Miyazocki, *et al.* (1981) reported that drugs dispersed in chitosan gels were released at a constant rate and so chitin and chitosan could be useful vehicles for sustained release of drugs. Min Hows, *et al.* (1985) reported that sustained release of indo-methacin was possible, using indo-methacin chitosan granules. The use of chitosan as a contraceptive was patented by Smith (1984). Convertic and pharmaceutical emulsions could be produced using chitosan (Patent 1984—Shisudco Co. Ltd.). Gross, *et al.* (1982) have investigated on the use of chitosan in hair dyes and other cosmetics and reported that chitosan can be a useful ingredient in hair cosmetics without the disadvantages of the synthetic polymers used generally for the same purpose.

Agriculture and food

Brown, *et al.* (1982) demonstrated the efficiency of chitinous materials in the control of nematodes, parasitic nematodes in ornamental plants, cucumber, tomato, etc. The use of administration of prawn shell powder in the soil has been reported to have controlled the rootwilt disease in cotton plants (C.T.R.L., Coimbatore). Chitosan has also found application in pesticides due to sustained releasing properties.

Zaikakis, *et al.* (1982) reported that the addition of 2% chitin in broiler diet containing whey had improved digestibility of whey in broiler chicken and improved the feed efficiency ratio compared to control diets without chitin. Ramachandran Nair *et al.* (1985) have reported increase in average live weight and dressed weight, decrease in wastage during dressing and decrease in feed consumption in birds (broiler chicken) fed on diet containing 0.5% chitin compared to the chitin free diet. Feeding of diet containing 0.5% chitin, for 8 weeks has resulted in an increase of about 140g, meat per bird compared to the birds fed on chitin free diet. The use of chitin in poultry feed is a very practical approach towards the utilization of chitinous waste which can cause a significant increase in meat production.

Conclusion

We have seen that chitin, chitosan and their other derivatives have versatile properties which can be put in various fields of application. It has been reported that once Eastman Kodak quoted US $ 113.40 per one pound of chitosan for application in photography. In spite of the abundance of chitin in the environment and the versatile uses of this material, this has not received the attention it deserves. If the results of the recent research are implemented commercially, we can expect a sudden boost in the use of chitin, chitosan and other derivatives which may result in the large scale production and use of this still under utilized fishery byproduct.

While chitosan is now being commercially used abroad for flocculation purposes, greater attention seems to have been received in the use as a growth promoter for poultry, in India recently. M/s. Oriental Chemical Industries, Cochin, has exported significant quantity of chitosan to overseas market and many entrepreneurs are now coming forward for production of chitin and chitosan probably for using as growth promoter. Other probable applications are yet to capture attention from the actual users.

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RECOMMENDATIONS OF SESSION IV

1. Having realised that the sector Exporting frozen prawns and other fishery products in Karnataka is facing the following constraints for further expansion:

(a) low level of availability of raw material,
(b) increasing assessment of different taxes and fees, and
(c) decrease in operating efficiency of plants and mechineries due to age,

and after discussing the various aspects in detail, the Seminar makes the following recommendations:

(i) Greater emphasis and encouragement should be given for Brackishwater culture programmes and to allot suitable Govt. waste lands for practicing brackishwater prawn farming to the nearest farmer on lease or hire.

(ii) The Fishery Survey of India (FSI) should intensify its surveys specifically for location of new viable shrimp fishing grounds in the offshore areas.

(iii) The levying of the purchase tax, Agricultural Products Marketing Committee (APMC) cess and Marine Products Export Development Authority (MPEDA) cess on seafood exports may be reviewed to reduce the increasing product costs.

(iv) The present system of levying inspection fees based on the FOB Value may be reviewed.

(v) For modernisation of the various processing plants and acquisition of new equipments the MPEDA may consider the grant of a subsidy of 30%.

2. The Seminar discussed, at length, the present status and problems of the Marine Products canning industry in Karnataka. To utilise the present canning capacity and to increase the production of canned seafoods the Seminar recommends that the following steps may be taken.

(a) Assuring a continued supply of raw materials, improving storage facilities for storing raw materials either by better utilisation of existing capacities or by providing new facilities.
(b) Diversifying the canned products.
(c) Promoting consumer acceptance of canned products through exhibitions, fairs and other extension channels and through subsidies.
(d) Making available all types of cans of a range wider than presently available.
(e) Initiating a crash sales promotion programme for Indian canned marine products in different external markets, especially in the Middle East and other developing countries.

3. Having felt that the transfer of improved technology to the fish curing industry is totally inadequate, it is recommended that steps should be taken for a rapid extension of the improved technology to fish curing sector by the research institutions.

4. The Seminar felt that most of the diverse fishery products developed by the several research organisations have not been taken up by the commercial sector for production and marketing, mainly due to fears on their acceptability by consumers. In order to obviate the production and marketing of these unconventional products and the marketing of unconventional species, especially from the deep sea fishing sector, action may be undertaken by the Karnataka Fisheries Development Corporation as a crash development activity subsidised by the Government.

Session V: Fish Handling Distribution and Marketing

Infrastractural requirements in Marine Fisheries with special reference to Dakshina Kannada

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ABSTRACT

In the marine fisheries development map of India, Karnataka occupies an important position. Over the past nearly three decades, considerable progress has been achieved in Karnataka in the development of the State's marine fisheries. By introduction of mechanisation in fishing in a big way and use of improved fishing crafts and gears, the area of fishing operation has been significantly extended, resulting in higher fish landings.

The infrastructural requirements in marine fisheries are highly varied. Before mechanisation, landings by the traditional crafts and gears were scattered all along the coast. However, with the development of mechanisation in fishing and modern methods of preservation, the situation has changed considerably. An account of the infrastructural requirements for landing and berthing facilities, fishery link roads, processing plants, with reference to Dakshina Kannada is given in the paper.

Introduction

In the marine fisheries development map of India, Karnataka occupies an important position. At the time of reorganisation of States in 1956 when the two coastal districts of Uttara Kannada and Dakshina Kannada were added, Karnataka became a maritime state. These two districts have about 300 kilometres of coastal line with a continental shelf area of about 25,000 sq.km. About 10,000 sq.km. of the shelf area is being exploited at present. Rich in a wide range of species, especially in prawn and pelagic fish the continental shelf area is a highly potential source of marine fisheries for the State of Karnataka.

The establishment of an independent Department of Fisheries in 1957–58 by the State Government paved the way for an all round development of fisheries in the State both in marine and inland sectors. Over the past nearly three decades considerable progress has been achieved in Karnataka in the development of the state's marine fisheries During this period, with the introduction of mechanisation in fishing in a big way and improved fishing crafts and gears. the area of fishing operation has been significantly extended. This has resulted in increased fish landings in the coast. The marine fish landings which was about 80,000 tonnes during 1956–57 has increased to 1,68,000 tonnes during 1984–85 with wide fluctuations over the years with the highest catch of 1,91,026 tonnes during 1979–80 and the lowest catch of 44,469 tonnes and 55,076 tonnes during 1961–62 and 1972–73 respectively. There has been a significant increase in the value of the fish landed from Rs. 160.00 lakhs during 1956–57 to Rs. 4,461.37 lakhs during 1984–85. Now more than 90% of the marine fish landings is

from the mechanised sector reversing the earlier pattern when more than 90% of the landings was from traditional fishing.

Infrastructural facilities

The infrastructural requirement in marine fisheries is highly varied. Before the advent of mechanisation in fishing, the traditional Rampani fishing operation was wide spread along the coast when fish landings have been scattered all along the coast in a large number of centres. There were other methods of traditional fishing too in these centres. Thus, there were fishing activities in a number of centres and also, a number of fish curing yards along the coast. In the government fish curing yards salt was supplied at a subsidised rate for fish curing and most of the surplus fish other than for fresh consumption were preserved by curing and drying. However, with the development of mechanisation in fishing and modern methods of preservation, the situation has changed considerably. Along with this, the infrastructural requirement in marine fishing has gained significant importance.

The infrastructural requirement in marine fisheries can be listed as follows:

Landing and berthing facilities: With the development of mechanisation in fishing landing and berthing facilities occupy an important position among the infrastructual requirement in the marine sector. As a result of mechanisation the fish landing activities have been concentrated and restricted to a few selected centres along the coast. The infrastructural requirement under landing and berthing facilities include landing jetties or wharf, auction halls, processing halls, packing sheds, other facilities like diesel outlets, supply of fresh water, etc. At present the mechanised fishing boats land their catches mainly at Mangalore, Hejamady, Malpe, Hungarkatta, Gangolli and Shiroor in Dakshina Kannada District. At times, during fair season, they land their catches in other small centres too. Infrastructural facilities in the form of wharf is available at old Mangalore Port to land the catches of mechanised boats. Construction of a minor fishing harbour is in progress at Mangalore which will provide additional landing and berthing facilities. At Malpe, the all weather fishing harbour provides the required landing and berthing facilities to about 100 purse-seiners and 400 to 500 small trawlers. There is a proposal to develop the second stage at Malpe which when taken up will cater to the needs of sea fishing vessels. Fish landing jetties are available in other centres. There are proposals to construct fish landing jetties at Sasihithlu, Hungarkatta, Kundapur-Kodi, Shiroor and other centres.

Fish preservation and processing facilities: Fish is the most perishable of human food materials. In fish, spoilage sets in almost from the time it is taken out of water. Therefore the application of post harvest technology in handling preservation and processing right from the catches are landed needs no over-emphasis. For proper handling, preservation and processing of fish a number of ice plants, cold storages, freezing plants, frozen storages, canning plants and fish meal plants are established in the private, public and co-operative sectors along the coast. The establishment of these plants has changed the mode of disposal of fish landed and the utilisation pattern of fish.

Fisheries link roads: Fish, being highly perishable, has to be transported immediately from the landing centres to the marketing centres or processing units. Before mechanisation the landings by traditional fishing have been scattered all along the coast. There was need to link the landing centres

along the seashore to the national highway or nearby marketing centres. Therefore, fisheries link roads were formed along the coast connecting the landing centres to the national highway or marketing/processing centres. Besides transport of fish, these roads are the means of communication in the fishing hamlets which have helped the fishermen considerably.

Fish transport facilities: Transport of fish has to be given due importance. In this connection, transport facilities form an important item of infrastuctural requirement. Fresh fish for shorter distance is transported in autorickshaws, tempos, vans, lorries etc. without ice and duly iced for long distances. A large fleet of transport vehicles mainly in the private sector is engaged in providing transport facilities for fish very efficiently The State Government, D.R.D.S. and the Social Welfare Board have sanctioned financial assistance to Fisheries Co-operatives to procure fish transport vehicles. The Karnataka Fisheries Development Corporation Ltd., Mangaloie and the private fish processors own insulated vehicles for the transport of frozen fish.

Fish markets: Marketing is the ultimate aim of production and production has no significant value unless it has got its own satisfactory outlets. Thus the final stage of disposal of the produce is to find a suitable market. The fish landed at the landing centres are disposed of mainly by auction and these fish are also to the consumer at the various fish markets. In order to promote marketing of fish under hygienic conditions, the Department of Fisheries has a scheme to assist local bodies like village panchayats, Town Municipalities, etc. to construct fish markets on 50 : 50 loan-cum-subsidy basis upto a maximum of Rs. 50,000/–. So far eleven such bodies have availed these facilities.

Developing internal markets for frozen fish products*

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The Karnataka Fisheries Development Corporation (KFDC) is marketing frozen fish in both coastal and inland markets. Marketing is easier only in the lean season, commencing May. During the regular fishing season, there exists a stiff competition from the fresh fish market. The sale price of frozen fish is fixed in accordance with the prices prevailing in the fresh fish market. It becomes increasingly hard to keep the frozen fish prices at the levels of fresh fish prices, as the cost of storage of 5 to 6 months adds on to the product cost. Given the choice, the consumer always prefers fresh to frozen fish.

Frozen fish is distributed by KFDC through a cold chain net work. There are 60 outlets for retail sales, out of which 25 are owned by the KFDC. These outlets are concentrated in south Karnataka. Export of fish by KFDC, mainly to the Arabian Gulf, has been quite negligible due to various constraints in export conditions and procedures. Fish worth about Rs. 75 to 80 lakhs has been marketed internally.

The existing marketing infrastructure built up by KFDC can be made use of profitably by private concerns.

*Prepared from observations made by Mr. U. J. Kedarnath.

Recommendations of Session V

1. Infrastructural facility for post-harvest requirement is inadequate in coastal Karnataka and especially so in North Kanara. This has to be looked into.

2. Marketing of fish through Fisheries Co-operatives should be mandatory. The volume of fish trade handled by KFDC should be increased.

3. Construction of refrigerated ware houses should be given priority.

Session VI

Marine Fishery Development Plans

I. Opening observations made by Mr. B. L. Kotbagi, Joint Director of Fisheries in Karnataka.

For the overall development of fisheries, there is need for adequate fisheries statistics and socio-economic studies of both inland and coastal fisher-folk. A point of saturation has already been reached in the inshore fisheries. The following areas are identifiable for further development: 1. Brackish water fish-culture, 2. Deep sea and off shore fisheries, 3. Diversification of fishing gears and crafts, 4. Infrastructural facilities, 5. Fisherfolk welfare measures, 6. Fisheries co-operatives, and 7. Fisheries legislation.

Brackish water fish culture: The immediate need for development is in this field, but there are special constraints in the State. 90 to 95 per cent of the cultivable brackish water area belongs to a number of private owners, making it difficult to initiate and develop programmes immediately. The cost of construction of brackish water ponds is exorbitantly higher than the limit fixed by the Government of India. There are problems of availability of prawn seeds. Agencies like MPEDA should set up prawn hatcheries. It should be noted that, according to the Bay of Bengal Programme, polyculture is economically viable rather than prawn, culture alone in brackish waters.

Deep sea and off-shore fisheries: Joint ventures in deep sea and off shore fishing activity seem called for. The communication gap between the states and the Central Government regarding promotional and subsidy facilities has led to lack of interest in deep sea fishing along the Karnataka coasts. There is also need for a proper survey of deep sea fisheries resources.

Diversification in fishing crafts and gears: There seems to be no further scope for increase in purse-seiners and trawlers, but there may be some scope for increasing the number of gill net units. Concerned agencies should suggest other new crafts and gears suited to Karnataka coast.

Infrastructural facilities: Karnataka is lacking in adequate infrastructural facilities for fishing and this is an important area needing developmental attention during the next decade. The state government is keen on developing fishing harbour facilties at Mangalore, further development at Malpe, and in the development of fishery link roads.

Fishermen welfare measures: It is important to plan for welfare measures for the economically backward sections of fisherfolk in terms of education, water supply, medical facilities, housing etc.

Fisheries co-operatives: The State Government has taken various measures to strengthen and improve the functioning of fisheries co-operatives.

Fisheries legislation: No state has got a perfect fisheries legislation and Karnataka is no exception in this matter. There is need for a uniform legislation for all the maritime states. The existing bills in Karnataka are: the Karnataka Inland Fisheries Regulation

Bill, the Karnataka Marine Fisheries Regulation Bill and the Fisheries Terminal Authority Bill.

For effective fisheries regulations, there is need for better coordination between the Department of Fisheries, Forests and Pollution Control Board.

II Supplementary observations made by Dr. P. S. B. R. James, Director, CMFRI, Cochin.

The State Government should not allow increase in the present number of trawlers and purse-seiners. There is scope for drift gill netting for quality fishes like seer.

There is need to introduce intermediary crafts to be operated beyond 50 m for identified resources like carangids, catfishes, pink perch, lizard fish, black rub, bulls eye and white baits. While long-lining has to be introduced for exploiting yellow fin tuna resources, purse-seining could be used for little tuna resources.

For immediate use, the State Government can make use of existing prawn seed resources available in coastal waters and estuaries. In brackish waters, prawn culture should be given priority over fish culture at present. Nine different centres have been identified by CMFRI as suitable for this purpose in Karnataka.

There is need for environmental monitoring and controlling of inshore areas from pollution. Responsibilities should be delineated between the Departments of Forests and Fisheries for the conservation of marine endangered species and their resources.